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1942.

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## NOTICES.

FELLOWSHIP OF THE ROYAL STATISTICAL SOCIETY is attained by election. A CANDIDATE must be proposed and seconded by Fellows of the Society, who, either from personal or general knowledge, vouch for his qualifications and eligibility. On the approval of the Council, Candidates may be elected as Fellows by a Ballot taken at any Ordinary Meeting of the Society.

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The INDUSTRIAL and AGRICULTURAL RESEARCH SECTION, was formed in 1934 for the study of problems concerned with the application of statistical methods in industrial and agricultural production, and published its work in a *Supplement*. All activities of the Section have now had to be suspended, and publication of the *Supplement* ceased for the present with Vol. VII.

The Ordinary Meetings of the Society are normally held each month during the Session (November to June) and the Research Section meets four times during the Session. Owing to the War, meetings were not held during the winter, 1941-42, but were resumed in March, 1942.

Particulars of all the Meetings are advertised in "The Times" on the preceding Saturday. Card notices are sent to all Fellows within reach of London, and to others on request.

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# JOURNAL OF THE ROYAL STATISTICAL SOCIETY PART I, 1942.

BRITISH LOSS OF LIFE IN THE WARS OF 1794-1815 AND IN 1914-1918

By MAJOR GREENWOOD, F.R.S.

IN giving judgment in an appeal, a Lord Justice was reported to have spoken (*obiter*) of the war of 1914-18 as a minor conflict, and to have stigmatized the ignorance of those (perhaps the widows, fathers, mothers or sweethearts of the 700,000 men of the Empire who lost their lives) who termed it the Great War. The phrasing may not have been happy, but if the judge were thinking of the spiritual issues and implying that an analogy between 1939-(?) and 1793-1815 is closer than between 1939-(?) and 1914-18, he had a case.

There must be still living some who have spoken with persons who saw Napoleon Bonaparte, and many who have heard a first-hand description of "The Duke," but June 18th, 1815, was a long time ago and the final discomfiture of the last egotist dreaming of universal domination, who was also a man of genius, so complete that we are inclined to forget what those who endured the struggle, felt and thought. We are almost nightly admonished not to give way to facile optimism (facile optimists I do not meet, but perhaps they are statistically important); very few British statesmen of the age of Bonaparte needed that reproof. Any miscellaneous collection of private letters written by well-informed people between 1794 and 1813 verifies that statement. Down to 1800 their fears were mainly spiritual; then, from the rupture of the negotiated peace of Amiens to October 21st, 1805, came a fear of invasion; thereafter, down to what seems to us the very morning of victory, a sense of frustration.

Fortescue \* reckons June 25th, 1807, the worst moment of the Great War since the mutiny at Spithead in 1797. On that day the Tsar became Bonaparte's ally. Bonaparte was master of all western Europe and about to inaugurate his New Order. *Our* military means of combating this plan consisted, according to Fortescue, of 8,000 soldiers available for expeditionary purposes. Fifth columnists in dominated territories were abundant; Goethe was a more presentable supporter than Quisling or even Darlan. It is doubtful whether German sheep were shorn as closely by Bonaparte's agents as they had been—and were to be again—by their native shepherds.

It took several years of the New Order, an attempt to extend its blessings to Spain and Portugal and finally to Russia, to bring it to an end. Before it was brought to an end, we were to experience humiliating defeats. Thinking of these things, it seemed to me of interest to go through the old literature and summarize the comparative costs to the United Kingdom of that war and of the minor conflict of 1914-18 in terms of human life.

\* Fortescue, *Life of Wellington*, p. 67.



In 1923 the Carnegie Endowment for International Peace published a volume on *Losses of Life Caused by War*,\* edited by our Honorary Fellow, the late Harald Westergaard. This covers the whole ground from the eighteenth century to 1918, and is of much interest, but all the information relating to British losses in the war of 1793–1815 is derived from two papers in our own *Journal*. I am not sure that all will agree with the editor's remark that the investigation proved "the extraordinarily small dimensions of the losses as compared with those of the last war (viz., 1914–18)." But as, in the sentence following that quoted, Westergaard speaks explicitly of the wars between 1815 and 1915, he *may* not have intended the remark to apply to the age of Bonaparte.

William Barwick Hodge, fellow of our Society and of the Institute of Actuaries, whose two memoirs appeared in our issues of September 1855 and September 1856 † (I note that Prince Albert was present at the reading of the former paper), commands my respect. Sometimes the badness of naval and military data moves him to protest (as it has later statisticians), but he never loses either his temper or his courage.

Let us begin with the senior service, the subject of Hodge's first paper. Official publications relating to the Navy of 1793–1815 were confined to numbers of men voted and returns of killed and wounded (even the latter were not always published). But the meagre official publications were supplemented by the researches of William James, whose *Naval History of the War* (published in 1822–4) contained information extracted from the log books preserved at the Admiralty.

Hodge first directed his attention to determining the proportion of the wounded who died. He concluded that this proportion was 10 per cent. He based his conclusion upon two rather modest sets of data, Sir Gilbert Blane's account of Rodney's victory in 1782 and Drinkwater's return of wounded among the garrison at the siege of Gibraltar, 1779–83. The former covered 810, the latter 1,118 wounded men. "The proportion of deaths among the wounded in engagements on land, was during a considerable period of the Peninsular War 130 per 1,000, or very nearly 1 in 8; and it can hardly be doubted that from the greater hardships to which wounded soldiers are exposed, the mortality among them must be in a greater ratio than among the wounded at sea, assuming the injuries in both cases to be equally severe."

Readers of Smollett and Marryat may take leave to doubt whether the situation of wounded men on ships at sea was more enviable than that of soldiers, but I have no better means of judgment than Hodge. Hodge also assumed that the returns of killed and wounded were defective, and added 2 per cent.; why he chose this precise figure is not stated. In this way he reaches a total of 6,663 lives lost by, as we should say, direct enemy action. His next item is of men who lost their lives in wrecked or accidentally burned ships; this is 13,621. He naturally takes up the point that, had there been no war, some ships would have been wrecked or burned, and equally naturally points out that in war-time, when ships must be at sea in all weathers, the risks are greater. According to a calculation he made, had the losses been double the rate of 1815–50, the deaths on a peace establishment would have been 1,636. So he takes 11,985 as the war surcharge.

\* *Losses of Life Caused by War*, by Samuel Dumas and K. O. Vedel-Petersen, edited by Harald Westergaard. Oxford, 1923.

† *Journ. Roy. Stat. Soc.*, Vol. XVIII, p. 201; Vol. XIX, p. 219.

His last item—additional deaths arising from disease and ordinary accidents caused by the war, 44,662—is more than double the sum of the other items. To a medical statistician Hodge's method of reaching an estimate is the most interesting part of his paper.

Hodge rightly says that it is the excess mortality due to disease in war-time over that of peace which is required, a point not appreciated by the authors of the Carnegie Publication. So, as rates of mortality will be involved when comparisons are made, his estimate of exposed to risk is important. He had actual data of exposed for three years only. For 1811-13 Sir Gilbert Blane (who had gone through unpublished official data) gave the numbers of men actually serving on board ships of war (January 1st of each year) and numbers voted as follows:—

Year				Actual number	Number voted
1811	...	...	...	138,581	145,000
1812	...	...	...	136,778	145,000
1813	...	...	...	138,324	140,000

Hodge had for other years only the numbers voted, and argued that the numbers serving would bear the same proportions to numbers voted as in the three years 1811-13. He made some small modifications which need not be detailed because his final average of 110,180 men does not differ materially from the average of men voted; the latter is of course larger, but by only 4.26 per cent., and if, as some naval officers told Hodge, his method under-stated the whole numbers *serving*, his basal number leads to an under-estimate of sickness losses.

Hodge then gives mortality rates for "diseases and ordinary accidents" for 1810-12 (*i.e.*, from Blane's data), and for the West Indian Fleet 1780-82. The former was 38.3 per 1,000, the latter no less than 58.0. Next he gives the rates for the Navy for 1830-36 inclusive. The death rate from all causes was 13.8, from diseases 11.8. He concluded that in war-time mortality from disease was at a much higher rate than in peace-time, and confirmed this by a comparison of rates on the East Indian Station in peace (1830-39) and war (1840-42). In the peace periods, 1830-6 and 1837-9, the rates were 15.10 and 14.34 per 1,000, in war 36.78. The respective mean strengths were 1,849, 1,883 and 5,156. The figures are small, but show a difference of the order of 20 per 1,000, and Hodge finally adopts as a "fair and moderate estimate" a war surcharge of mortality from sickness and ordinary accidents of 16.0 per 1,000 strength.\* Applying this to his average of 110,180 for 20.45 years, he reaches 36,051. But, had the country not been at war, the establishment would certainly not have been so large; he thinks 40,000 an over-estimate. So he must determine how many of the 70,180 men who would not have been in the Navy would have died annually. It occurred to him that they might have been mercantile sailors, but he rejects this on the ground that "the trade of the country was carried on, by some means, during the war," so that the excess must have come, "so far as it was not met by the employment of foreign sailors," from civilians. He assesses their mortality from Farr's first life-table (assuming an average age of 30), and adds the difference between the expected deaths on this basis and the expected naval deaths at the rate of 16 per 1,000 to his 36,051, reaching a grand total of 44,662. That in the war against Bonaparte sailors died of disease at a rate we should now expect in men of say,

\* This amounts to assuming that the war-time rate was double the peace-time rate.

sixty, is a horrifying picture, but there is certainly no reason to think it an exaggeration. I suspect that Hodge was a *little* optimistic in his estimate of civilian mortality among the classes preyed on by the press gangs, and may have overstated the proportion of land-lubbers in the war-time Navy. But I can detect no gross error. So if we round off his numbers, take 7,000 for direct enemy action, 12,000 for shipwreck and 45,000 for disease, a total of 64,000 lives, that was the cost of the war to the senior service.

I now pass to Hodge's second paper, on military casualties (I omit all his details of particular naval operations; they are picturesque but not relevant to my general theme). Looking back over 130 years, it may be difficult to decide whether the Admiralty or the War Office blundered more grossly in administration, but it is part of our ritual to regard the War Office as fair game and to respect the Admiralty. Hodge followed the tradition. He ventures no nearer to a criticism of the Admiralty than to opine that his hearers would share the astonishment of "an enlightened foreigner" that it "was not until the year 1810 that the English Admiralty required regular annual returns to be made to them of the deaths which took place on board the ships in the Navy."

The War Office, which did compile statistics—inaccurate, indeed, and sometimes misleading, but still statistics—is not let off so lightly. Hodge begins his paper with a criticism of the defects of the new (1854) system of publication of nominal rolls, and follows it with two pages of quotations of rude (and true) criticisms introduced by these words: "There seems to be a general impression that the experience acquired by recent disasters will lead to such a permanent improvement as to preclude the possibility of their recurrence; but the student of our military history will find too many subjects for humiliation and anxiety to join readily in such a belief." Strictly speaking, these matters were irrelevant (no doubt, even in our austere circle, events in the Crimea in 1854, like those in Mesopotamia in the last war, had tried tempers) to his theme, so it is not surprising that his purely statistical criticisms of data are not lenient. For exposed to risk he had the Adjutant-General's returns, which, even when not defective, set traps for the unwary. Thus N.C.O.s, although included in returns of deaths, discharges or desertions, were not included in effective strengths. Hodge found from other data that N.C.O.s averaged 72 per 1,000 of rank and file, and so made a correction. Commissioned officers did not appear at all, except in a solitary return relating to May 11th, 1814. Then there were difficulties (for some years) due to confusing British with foreign regiments in our service and difficulties about discharges. Hodge obtained from the criticized Adjutant-General's returns a gross total of 198,781 deaths. He increases this by 5,079 for defective returns in three years; the total covers infantry and cavalry, but not Artillery and Engineers. For their strengths he had data for only five years, and he assumed their mortality to be 20 per cent. lower than for infantry and cavalry (why, does not appear), and adds 15,560 to the total, now reaching 210,420. Finally he adds for deaths among the "missing" 2,003, so the grand total of deaths among N.C.O.s and rank and file becomes 221,423. To reach the losses due to direct enemy action Hodge added to the numbers killed one-eighth of the wounded for N.C.O.s, rank and file and one-twelfth of the wounded for commissioned officers. He obtained these ratios from particular (not very large) collections of data. His estimate is 26,879.

Hodge next allows for peace-time mortality by the same method as applied to the naval losses. He supposes that, had there been no war, the average strength, instead of being 198,578, would have been only 80,000, assumes an annual mortality rate of 10 per 1,000 for civilians and 30 per 1,000 for soldiers (in peace-time), and estimates that 80,385 deaths must be deducted from the 221,423, leaving 141,038. Adding to this 2,770 deaths of officers (killed in action 1,310, estimated excess of mortality from disease, 1,460), one has for the total estimated excess mortality caused by the war 143,808. So the cost to the armed forces of the country was, in round numbers, 64,000 for the Navy, 144,000 for the Army, 210,000 lives. In the Navy deaths from disease (*excess* deaths over peace-time rates) more than doubled the losses from enemy action, in the Army they were eight times as numerous. A dramatic example of epidemic disease, the fate of the Walcheren expedition, is described in an Appendix.

In general, it seems to me that Hodge's figures are of the right order of magnitude, but too small. Two points arise. His figures give 113,273 desertions. No doubt a large majority of these were just desertions, but some may have been, shall we say, final desertions. Then, of the 229,141 discharges, *some* surely were of men broken in the wars and doomed to premature deaths. So, perhaps, Hodge under-estimated the gross mortality. Let us now compare these results with those of the war of 1914-18.

#### *British losses in 1914-18*

The statistical data available are far more extensive than those Hodge had to use, but to make a fair comparison with 1793-1815 is not easy. One must, for instance, exclude the losses among Dominions troops, because, statistically speaking, the old war was fought by the inhabitants of the United Kingdom, and this cannot always be done. Then--and this is much the greatest difficulty--while in 1793-1815 civilian losses of life directly or indirectly due to the war were either unrecorded or negligible, in 1914-18 they were important. The unrecorded losses in the French war were those of the merchant marine. The enemy made prizes and, as readers of fiction know, privateers were common. The losses of life thus produced would not come within Hodge's field, and I do not know how to estimate them. The negligible losses are those due to direct enemy action against the civilian population or disease consequent upon a lower standard of living. In 1793-1815 these were certainly negligible; indeed, there is good evidence that the general health of the people improved fairly steadily down to the peace of 1815, and then deteriorated. I see no reason to doubt the conclusions reached by Creighton and others that one factor of this improvement was a higher standard of living in the working classes made possible by higher real wages in war-time.

This factor more than counterbalanced any harm done by the introduction of disease from abroad, and during the period there was no deadly epidemic of influenza. It was not until *after* the war that a price had to be paid, and a heavy one. It would take me too far afield to discuss that, but it is proper to remark that when one begins to take account of the indirect consequences of war, it is not easy to tell where one should stop.

Several estimates of the direct losses sustained in 1914-18 are available. These differ appreciably, because they were compiled at different dates and do not relate to the same exposed to risk. I begin with a rough estimate using

Hodge's own method and the data printed in the Carnegie volume (I supplemented this with an estimate of the mean Army strength, which came out to be 3,100,000). We have 48,000 deaths in the Navy and mercantile marine, 724,000 in the land forces, 772,000 in all. On a mean strength of 3,100,000 soldiers and 280,000 naval forces, assumed to have died at an approximate rate of 4.8 per 1,000 per annum (the  $q_{30}$  of E.L. 8), we must deduct 65,000 deaths, leaving 707,000. The only Carnegie table showing Dominions losses separately makes them 22 per cent. of the total, so the United Kingdom quota is 551,000. Now divide by 2.5 to reduce to the population level of 1811, and we reach 220,000 as the figure comparable with Hodge's estimate for 1793-1815 of 210,000. The roughness of the method is obvious. From figures supplied by Dr. Isserlis and by a friend in the Admiralty, I think the sea losses are underestimated, but I cannot tell to what extent. Thus my naval friend's information puts the deaths in naval forces at nearly 43,000, while the Carnegie figure for *Royal Navy* is 33,361. But I am not clear that the two categories are the same. Dr. Isserlis's data agree with the Carnegie total for mercantile marine, but add 6,330 deaths of passengers not included in the Carnegie total. If we add 5,000 to the 220,000 estimated, we shall perhaps not be far wrong.

It follows that, so far as concerns the fighting forces, the war against Bonaparte was more costly than the war against Wilhelm II. As we shall see, the allocation of these losses to direct enemy action and disease differs enormously from that of the old war, but, before going into detail, something must be said about civilian losses actual and potential.

First, one has the direct consequences of "total war" as practised in 1914-18. We have seen that 6,330 sea passengers were drowned, and it appears that 2,059 civilians were killed in air raids or coastal bombardments. These are obviously chargeable items, and—adding their sum divided by 2.5—increase the estimate by 3,355.

Next we have deaths among civilians due to an increased death rate in war-time. Now we begin to tread upon dangerous ground. It seems reasonable enough to hold that some of the increased mortality during 1914-18—for instance, from tuberculosis—ought to be debited to the war. But far the largest war-time item was the pandemic of influenza, and to assert dogmatically that this was a war epidemic, in the sense that the typhus in South-eastern and Eastern Europe was a war epidemic, is quite unjustifiable. Personally, I believe that the war was responsible for its unprecedented fatality; but that is only my opinion; other epidemiologists do not agree. Our experience in this war, *so far as it has gone*, does not confirm theoretical expectations.

In the Carnegie volume, Vedel-Petersen estimated excess civilian mortality in the following way. He found that for 1908-14 the ratio of deaths at ages over 1 year to *total* population was 11.30 per 1,000. He assumed this ratio to be stable, applied it to the estimated civilian population of each war year, added to the products the recorded deaths at ages under 1 year, and took the sums so formed to be the expected numbers of deaths. These he compared with the recorded deaths, and found the war-time excess to be 281,000. This is, I think, a reasonable, if rough, method (he applied some checks which seem adequate), perhaps too favourable, because, under normal conditions, the death rates might have declined. But of the total 281,000, more than 130,000 belong to the pandemic of influenza. So the war excess is from 281,000 to, say, 150,000, in accordance with our views on the ætiology of the pandemic.

These calculations relate to England and Wales, so we must multiply by 1.25 to reach an estimate for the United Kingdom, and then divide by 2.5 to pass to Hodge's scale—viz., divide by 2.0, having in round numbers 142,000 and 75,000. The result is, making the additions to my original 220,000 first of 5,000 for under-statement of military losses, then of civilian casualties, that the final estimates are 370,000 and 300,000, the latter close to Hodge's 322,000, the former rather larger. For reasons given above, I suspect that Hodge under-estimated the losses of his period, so that I am led to the conclusion that the direct cost, in terms of deaths, of the two wars was about the same. I need hardly point out that, like Hodge, I am handling the data from a *purely* arithmetical point of view. Economically and psychologically a bill which must be paid within four years is more onerous than one which is discharged by twenty annual payments. There remains the item of potential loss—viz., the number of lives which would have come into existence had neither war been waged. For the Napoleonic epoch and our own country, there is no reason to suppose that the war affected the birth rate at all; there was no arithmetical reason why it should, because the over-seas armies were small, and, as some would add, birth control was not fashionable.

In 1914-18 the case was different. Sir Bernard Mallet discussed the war-time decline of births in our *Journal* \* and estimated the shortage as of the order of magnitude of 500,000-700,000. I have made a similar calculation which leads to substantially the same result, so that I need not reproduce it. If we are justified in bringing this item into the debit account, then it is beyond doubt that 1914-18 cost relatively, as well as absolutely, far more lives than 1793-1815. It may, however, be questioned whether, if this item be admitted, there may not be credit items to set off. All the changes in public administration and ways of life which were legacies of 1914-18 were not for the worse; some of them may have led to a real saving of lives. This, however, leads to a train of thought which could be extended indefinitely.

Finally I return to the distribution of military casualties between direct enemy action and disease.

Hodge made the ratio of non-battle to battle casualties 8 to 1, in 1914-18 (land forces) it was 1 to 5.3.

In the statistics covered by the statistical volume † of the Official History, of 718,707 deaths, 113,173 were due to disease or injury (not due to enemy action).

It is not possible to work out from the data actual death rates from disease, because of evacuations to England from the main theatre of the war, but there is little reason to doubt that in France, Flanders and, of course, the United Kingdom, the death rate from disease was low.

There were, of course, theatres in which mortality from disease was heavy. In Macedonia the deaths from enemy action—4,096—only slightly exceeded deaths from disease—3,744. In Mesopotamia (British troops) battle deaths numbered 7,409, deaths from disease 4,775. In 1916 the death rate from disease was 43.45 per 1,000. In the Dardanelles, although battle deaths greatly exceeded deaths from disease—16,580 against 2,108—the death rate from disease exceeded an annual rate of 20 per 1,000. Still, in the aggregate the contrast between the two wars is enormous.

\* *Journ. Roy. Stat. Soc.*, Vol. LXXXI, pt. 1.

† *Official History of the War. Casualties and Medical Statistics.* London, 1931.

In my first draft of this paper I interpolated topical allusions to events of 1939–41. A friendly critic advised their omission, and further reflection convinced me that his advice was wise. Of course, one does not begin to write a paper of this kind without thought of the present struggle. It was curiosity to learn more than I knew of the way in which our great grandparents faced their Battle of Britain which led me to read many books about their war, and this arithmetical paper is a by-product. There seem to me lessons to be learned from the disasters and triumphs of 150 years ago, but a private citizen cannot know enough of what is happening now to draw conclusions. I have eliminated all topical references, and leave this paper as an exercise in very old-fashioned descriptive statistical methods.

### *Appendix*

#### *The Walcheren Disaster*

In Hodge's second paper he tabulates the losses sustained in the expedition usually known as the Walcheren expedition. Once famous, this disaster is remembered—if at all—by most people as the occasion of a quarrel between two politicians, or as having prompted some sarcastic verses. The forgotten story still has its lessons. The object of the expedition was to strike at a vital spot in Bonaparte's empire at a moment when he and his best troops were occupied elsewhere. Historians distribute the blame for its disgraceful failure in accordance with their estimates of Castlereagh, who was the Secretary of State for War.

Fitzpatrick (slight anti-Castlereagh bias) \* divides the blame between Castlereagh and the Earl of Chatham. Here is his account slightly abridged:—

"The magnificent arsenal and dockyards Napoleon had created at Antwerp, where ten French men-of-war were now on the stocks, constituted a formidable menace against the maritime supremacy and even the safety of the kingdom. With Belgium under the sway of such an able and ambitious ruler this was an inevitable consequence of the opening of the river Scheldt which Pitt had made a cause of war with the French Republic. The French Emperor, however, after his check at Aspern, had stripped the Netherlands of troops, in order to re-inforce his army in Germany; and it seemed quite feasible, by a sudden attack in overwhelming force, to capture Flushing and Antwerp, destroy the enemy's docks and shipping, and by holding possession of Walcheren to close the Scheldt more effectually than before. . . . The armament, alleged to be the most powerful that ever left the coast of England—from thirty to forty men-of-war with an immense crowd of frigates, and gunboats, and transports carrying forty thousand troops—sailed amidst a burst of national enthusiasm, but not until July 27th, in the height of the summer heats, and three weeks after Napoleon had relieved the strain on his resources by his victory at Wagram. And this delay made more imperative the observance of two conditions obviously essential to success: (1) energy and decision in the Commander; (2) proper precautions for the health of the troops about to encamp on a pestilential soil. . . . Lord Chatham whom he [Castlereagh] placed in chief command, had long before won for himself the reputation of being the laziest and most dilatory of all the public men of his time. As 1st Lord of the Admiralty, from which high post his brother Pitt had been compelled by public clamours to remove him for neglect of business, he was known throughout the naval service as the *late* Lord Chatham. . . . He compelled Flushing to surrender, but

\* *Report on the Manuscripts of J. B. Fortescue, Esq.*, preserved at Dropmore, S.O. 1915, Vol. IX, pp. lxxxix *et seq.*

delayed advancing against Antwerp until that city had been placed in a state of defence; and when the troops in Walcheren began to suffer from the exhalations of a swampy soil, it was found that no proper provision had been made to mitigate the ravages of disease in a situation so notoriously unhealthy that when news reached Napoleon at Vienna of the landing of the expedition, he predicted its speedy destruction by the operation of the climate. After a fortnight of bickering and indecision, Chatham, with the consent of the Cabinet, returned with part of his forces to England, leaving 15,000 troops in Walcheren to perish of Malaria."

The purely medical side of the disaster, if possible even more discreditable than the tactical and strategic, has been recorded by Dr. Arnold Chaplin.\* When Chatham returned to England on September 10th, he left 16,000 men to hold Walcheren, of whom 8,000 were already sick, and there was no doubt of the diagnosis—malaria, as we should now say—remittent and intermittent fevers due to miasmata, as our great grandfathers said. The senior medical officer on the spot (John Webbe) took a gloomy view: "The rapidity with which the disease has extended itself," he said, "during the short period that has elapsed is almost unexampled in the history of any military operations." There was an urgent demand for medical staff. On September 14th *one* staff surgeon and *three* hospital mates arrived, with the excuse from the Medical Board that, owing to the Peninsular War, no more were available. There was no suitable accommodation, blankets were short, and on September 23rd the G.O.C. reported that only 300 pounds of bark remained. At last the Government were roused, not to action, but to enquiry. The two official heads of the Army Medical Service, Sir Lucas Pepys, Physician-General, and Keate, Surgeon-General, were requested to proceed to Walcheren. Sir Lucas begged to be excused on the ground that he "knew nothing about the investigation of camp and contagious disease." This was certainly true, but, as, before and after, ignorance never prevented Sir Lucas from doing any medical job, a less charitable interpretation was given by his contemporaries. Keate also refused, for "he conceived he would be of greater use at home." The Government then appointed a medical commission consisting of Sir Gilbert Blane, Dr. J. Borland and Dr. W. Lempriere, and also made Dr. James McGrigor (of Peninsula fame), Inspector-General of Hospitals. The measure recommended—immediate evacuation to England of 6,000 sick in ships of the line (on October 1st)—was adopted, and McGrigor, who remained on Walcheren, brought some order out of chaos. But by October 29th only 4,534 men were fit for duty, and on December 9th the remnants of the army were embarked. Guns were got away on December 23rd—the end of a dismal adventure.

Hodge's statistics of the casualties are given in the table. It might have been expected that the return to the east coast of England of so many malarious patients would have been followed by a recrudescence of agues. This is not known to have happened.

The expedition produced three treatises (at least), one by Dr. J. B. Davis,† whose observations were made in Ipswich, one by Mr. G. P. Dawson‡ (also apparently based on hospital experience in Ipswich), and one by Dr. Thomas

\* *Medicine in England during the Reign of George III*, by Arnold Chaplin, M.D. London, 1919, pp. 91 *et seq.*

† *A Scientific and Popular View of the Fever of Walcheren*, by J. B. Davis, M.D. London, 1810, pp. 200.

‡ *Observation on the Walcheren Diseases*, by G. P. Dawson. Ipswich, 1810, pp. 133.



TABLE

*Showing the proportion of sickness and mortality among the troops employed in the expedition to the Scheldt in the year 1809*

Week ending	Officers				Non-commissioned officers and men			
	Proportion to 1,000 strength			Proportion of weekly deaths to 1,000 sick	Proportion to 1,000 strength			Proportion of weekly deaths to 1,000 sick
	Of sick	Of weekly mortality	Of equivalent annual mortality		Of sick	Of weekly mortality	Of equivalent annual mortality	
Sept. 10th, 1809	*	5.20	270	—	388	12.09	629	31.82
„ 17th, „	307	9.15	476	29.79	468	15.92	828	34.02
„ 24th, „	244	3.84	199	15.70	533	17.49	910	32.78
Oct. 1st, „	230	2.64	137	11.62	565	15.72	817	27.83
„ 8th, „	186	4.17	217	17.85	587	14.21	739	24.19
„ 24th, „	173	none	—	—	549	9.83	571	17.92
„ 31st, „	135	1.69	88	12.50	530	10.31	546	19.43
Nov. 14th, „	81	none	—	—	428	4.51	235	10.53
„ 21st, „	87	„	—	—	155	4.54	236	29.36
„ 28th, „	78	„	—	—	185	4.79	249	25.90
Average	166	3.48	181	8.75	470	12.30	640	25.38

\* No return.

Wright,\* who was physician to the Harwich hospital. The first two are purely clinical, and the third mainly clinical, although it records a case of severe malaria in a female nurse, derived, as the author supposed, by contagion from a patient. Dr. Wright (an Irishman), if not helpful epidemiologically, has a macabre pen:

“Harwich became the Lazaretto to the army of Walcheren; how accurately this designation suited the reality, may be learned from the Report of the Physician-General, who was present at the first landing from the Transports, from which the instant they cast anchor, twenty bodies were sent ashore for interment, and of the deplorable cases landed, eighteen died in one morning in transitu on the biers, nearly as many expired in the night in the Hospital, and every night after a considerable number, but perpetually decreasing; the pallid looks of the breathing spectres were so ghastly, they exhibited a type of the resurrection; and their unhappy attendants, too few to administer relief to half the number, through fatigue, were marked with melancholy little calculated to communicate hope or confidence to the sick; and thus tiresome days were succeeded by disturbed nights, banishing from the minds of the Physicians the resources which a memory less encumbered might have supplied; truly the state of the Hospital was so alarming that the people of the vicinity fled, and the backwardness of professional men to attend was such that the assistants who were with difficulty provided were worse than negligent” (pp. xv-xvi).

The reason why this influx of malaria-carriers did not generate an epidemic is, I think, to be found in James's paper.† James makes it probable that, as Creighton held, malaria was never widespread in England, and that the endemic

\* *History of the Walcheren Remittent*, by Thomas Wright, M.D. London, 1811, pp. 337.

† *Proc. Roy. Soc. Med.*, Sect. “Epidem.”, Vol. 23, pt. 1, 1930, pp. 71-87.

regions (the marshy east and south-east coastal districts) were restricted. James's explanation of modern diminution in these endemic regions is, I suppose, still controversial. But if we put weight, as he does, on economic factors, then the temporary prosperity of population in the malarious districts may explain why even there we have no evidence of serious mortality.

#### DISCUSSION ON PROFESSOR GREENWOOD'S PAPER

**DR. PERCY STOCKS:** Professor Greenwood modestly calls his paper an exercise in very old-fashioned descriptive statistical methods. When a writer of great statistical acumen has also a flair for history, we reap the advantages of the old method without its disadvantages, and for my part I find the exercise of extraordinary interest. My only regret is that those topical allusions to the present war were omitted. The problem of indirect war losses is, however, a speculative one, and of the direct losses it is inadvisable to attempt any estimates whilst the war is in progress. As Professor Greenwood has said, the influenza epidemics of 1918-19 introduced a very large uncertain factor into the computation of indirect losses attributable to the last war, and in the present war there have already been difficulties of a similar kind. The March quarter of 1940, before special hazards other than those imposed by the black-out had begun to affect the home front to any appreciable extent, was extremely cold, comparable in the present century only with 1917 and 1929. Had there been no war, the excess of civilian deaths then recorded would reasonably have been accounted for by the low average temperature, but in the presence of some additional rigours imposed by war, we naturally ask whether some fraction of the deaths was attributable to them, particularly in the case of old people. As to what fraction that was we can only speculate, for the causes of death provide no certain answer. Again in 1941 the March quarter was very little warmer when judged by average temperature than in the previous year, and once more there is the difficulty of distributing the blame for such excess as occurred, for we know that the hardships imposed on civilians by the war were not inconsiderable during that period. Whatever view is taken of these uncertain factors, the total excess of deaths indirectly attributable to the war up to the end of 1941 seems to have been remarkably small.

Professor Greenwood has also estimated the loss of births produced by the two great wars with which he deals. It is too early to say much of the present war in that connection, but there are two hopeful features, the first being that the birth-rate in 1941 was not appreciably below the level reached in the peaceful, though industrially depressed, year of 1933. The second is that the marriages registered in 1939 and 1940 were greatly in excess of the numbers expected from previous years, and that the bulk of the additional marriages were of very young women, thus increasing the potential fertility of the female population to a considerable extent. There are many aspects to be thought of here, such as the effect of the high birth totals of 1920 on the numbers of women reaching marriageable age, the influence of marriage allowances and so forth, and I have no doubt that this Society will debate them in the future when fuller knowledge is available. In the meantime it is better to leave the matter there, lest one more be added to that hypothetical category of "facile optimists."

**SIR WILLIAM ELDERTON:** The excess mortality in a period of catastrophe is the excess of actual deaths over the number that would have occurred if there had not been the catastrophe, *i.e.*,  $\Sigma \theta_x - \Sigma P_x q_x$ , where  $\Sigma$  covers all ages,  $\theta_x$  represents the actual deaths at age  $x$ ,  $q_x$  the normal rate of mortality and  $P_x$  the population adjusted appropriately to fit in with the use of  $q_x$ . The population in war-time is the total population, including the part serving away from the country; the normal rate of mortality varies from year to year, and all we

can properly say about  $\Sigma P_x q_x$  is that it lies between limits which we can judge by the variations in the rate of mortality in, say, the five years immediately before the catastrophe. If the rates of mortality in those five years (or such period as we may adopt) varied 5 per cent. from the mean, then the excess will lie between  $\Sigma 0_x - 1.05 \Sigma P_x q_x$  and  $\Sigma 0_x - 0.95 \Sigma P_x q_x$ , or even between wider limits if 5 per cent. is a narrower range than is known to occur in our experience of population mortality. If mortality has been decreasing or increasing during the period used in fixing  $q_x$ , then allowance may have to be made for the continuance of the trend. The number of actual deaths should be ascertainable, but, even where enumeration is good, some of the effects of a catastrophe may be carried over to subsequent years. When the catastrophe is a major war, there may be some decrease of general mortality due to physical training or to a simpler type of life tending to offset the deteriorating effects. This indicates that it is only the excess mortality as a whole that gives the measure we want, but we should, strictly, deal in age-groups, because a loss in early manhood is a greater calamity than a loss in old age. Having reached a measure of the excess, we may try to subdivide it by counting the deaths due to causes having no peace-time counterpart, and, having done this, we may try counting the deaths due to causes that have only a small peace-time counterpart. We may, then, appear to have accounted for all the excess, but any such apparently complete analysis will probably be illusory. In the paper the broad analysis of excess was impossible for the earlier war, for the reasons given or implied by the author; they amount to saying that we do not know the real number of deaths or the proper rates of mortality. Moreover, that war extended over twenty years, and large variations in normal mortality from year to year must have occurred. Bearing the difficulties in mind, I think little else could have been done with the material, and I should be inclined to be no more definite than to say that the excess of British deaths due to Napoleonic wars probably lay between 200,000 and 250,000. We can be less indefinite about the war of 1914-18, and I see no objection to the author's figures, though I should have liked to attempt the broad line of approach I have indicated, but this is impossible to undertake at the present time. It is worth mentioning that the age incidence of the population had changed in the hundred years between the two wars, and it might be better to reduce the deaths for 1914-18 in proportion to the population at ages, say, 18 to 38, rather than in proportion to the total populations. (It is not clear from the paper how the proportion of 2.5 was found, and I have had no opportunity to check it.)

The ratios of deaths in the forces from disease and wounds are interesting. In the Crimean War they were roughly 3 to 1, and in the Boer War 2 to 1.

The author's references to the Walcheren disaster and to Smollett and Marryat reminded me of Dickens's biting criticism (*Uncommercial Traveller*, Ch. VIII) of the scandalous condition in which discharged soldiers, some of them Havelock's men, were brought home from India.

The paper is very interesting, and will be of added value when an estimate of the loss of life in the present war can be made.

**SURGEON VICE-ADMIRAL SHELDON F. DUDLEY:** Professor Greenwood drew attention to the poorness of the navy's vital statistics in war. From 1916 to 1922 the compilation of the annual statistical report of the health of the navy lapsed. In Government Offices, during a war, more and more work is thrown on a less and less experienced staff, and any work that is not essential to the immediate war effort is shelved or neglected. Unfortunately, vital statistics is one of the first subjects to suffer in this way. The importance of keeping accurate statistics is realized by few of those in authority, and the statistically minded medical officer has a miserable feeling of frustration as he watches a unique opportunity of collecting invaluable data slip away, never to return.

In the last war, vital statistics for the navy were compiled up to the end of 1915. These returns throw some light on one or two points raised in Professor Greenwood's paper. In the seagoing fleets, excluding naval forces employed

in land operations, there were 8,685 casualties from the beginning of the war up to the end of 1915. 6,939 of these were drowned, killed, or died of wounds; 1,746 were wounded and survived. Thus, roughly, there were four killed to one non-fatally wounded. The high proportion of naval killed in the last war was the result of so many ships blowing up or sinking with all hands. In the older wars the wooden ships did not sink easily, and weapons were not so deadly; therefore, wounded sailors must have been more common than in 1914-18. In the present war, also, owing to the nature and frequency of air attack and the fact that ships do not seem to sink as easily or explode as often as in the last war, the killed to wounded ratio should be very much less.

There was a significant rise in the mortality from disease during the last war, as the naval death-rate, for diseases only, went up from 2.17 per 1,000 per annum for the five years 1909-13 to 3.45 for 1915, an increase of 60 per cent. The total death rates, including wounds and other injuries, were 3.21 and 22.05 for the same periods. The relatively low incidence of disease in the modern navy at war, as compared with the army, is due to the protection afforded from insect and water-borne diseases by a life at sea. Dysentery and malaria, which are still the curse of the army on active service, cause comparatively little trouble in ships. The high mortality from disease among the seamen of former times, in both peace and war, was, in the main, caused by scurvy and yellow fever.

Whatever may have been the case in Smollett's and Marryat's day, the wounded sailor, provided he was not drowned, had a better chance of surviving in the last war than the wounded soldier. In 1914-18 the sailor was usually clean, well fed, and sheltered when hit, and obtained immediate skilled attention. On the other hand, the soldier, more often than not, was dirty, exhausted, famished and exposed to the weather at the time he was wounded, and might have to wait hours and travel miles before he received efficient surgical treatment. In the last war up to the end of 1915, 1,884 sailors were wounded. Of these, 134 are recorded as dying of their wounds, a ratio of about 1 in 14.

The observation that the return of the Walcheren expedition produced no noticeable recrudescence of malaria in East Anglia is interesting. As the victims returned in the winter, however, no fresh infections could have taken place before the following summer, and only then if there was a sufficient spell of weather warm enough to allow the malaria parasites to complete their life-cycle in the insect vectors.

In 1914-18 the return of troops from the malarious theatres of war caused a definite outbreak of indigenous malaria in the Sheerness district. After the return of the ships from the China wars in 1857-60 many cases of "intermittent fever" were reported from Sheerness. These, in the main, may have been relapses among the ratings who had returned from China, but in 1874 it is specifically stated in the naval returns that there was a recrudescence of ague among the civilians in Sheerness, many of whom had lived for years in the district without having previously suffered from ague. The year 1874 coincides with the return of the Ashanti expedition, in which the naval forces employed were decimated by fever. Another threefold rise in the incidence of malaria on the Home station synchronizes with the return of the Benin expedition in 1897.

There can be little doubt, given a hot summer and plenty of anophelines, malaria-carriers returning from abroad can spread the disease in certain parts of England. It should, however, to-day be easy to guard against this danger.

SIR ARTHUR MACNALT: The thesis here is the determination of the excess mortality due to disease in war-time over that of peace in the two wars and to compare them. It is found that the direct costs of the two wars were practically the same, and that if civilian mortality in 1914-18 is brought into account, 1914-18 was the more expensive. As Professor Greenwood remarks (on p. 5), to make a fair comparison between the two wars is not easy. The conditions in Great Britain under which the two wars were fought were very different. In

1794–1815 the nation, while interested in the success of its struggle against France, did not fear invasion until after 1805 (*vide* p. 1). The British soldiers and sailors who fought were much fewer in numbers than those of 1914–18, and to a large extent were drawn from the poverty-stricken or disorderly sections of the population. “The French system of conscription brings together a fair specimen of all classes; our army is composed of the scum of the earth,” said the Duke of Wellington, with more accuracy than gratitude. The pressed men in the Fleet, as Marryat tells us, were often miserable specimens of humanity. In both services they were ill-fed, bullied, and flogged. These conditions were responsible for the outbreak of mutinies, notably the Mutiny at the Nore of 1797. Yet the men fought well both on sea and land. The high rates of mortality that occurred compose, indeed, “a horrifying picture,” but it is probably due to the defective physique of the fighting men as well as to the lack of organized medical care, hygiene, and ignorance of proper methods of treatment which then prevailed. For these reasons it might have been anticipated that the fighting men in the earlier war would show comparatively a much higher excess mortality than those of 1914–18. It must, however, be remembered that the war of 1794–1815 was mainly a naval war on the side of Great Britain. On land Pitt chiefly fought the war by subsidies to Austria and Prussia. It was not until the later stages of the war that Great Britain actively participated with land forces in the Peninsula and in the ill-fated Walcheren expedition described in the appendix to this paper. It was not only the high wages that prevailed at home in the war of 1794–1815 that accounted for good general health among the civilian population; but just as the nation in the last war had the resources of Victorian prosperity behind them, so the people of 1794–1815 had the resources of the agricultural prosperity of the early half of the eighteenth century at their disposal. In addition, Pitt’s administration made trade prosperous. The French could not exert an effective blockade, there were no submarines, and “British commerce was united with and made to flourish by war.” There was a heavy income tax introduced in 1798. It operated on incomes of no more than £60 a year, which were mulcted at the rate of twopence in the pound. The tax proceeded by a minute and complicated scale, each £5 of additional income being taxed at a different rate until £200 was reached. From incomes of £200 a year and upwards a tenth was taken. But it does not appear to have been responsible for any general impoverishment, malnutrition, or outbreaks of disease. The war of 1914–18 was much more a national affair. It affected every class of the community. There were large armies, a large navy and a growing air force. The German blockade was a menace, and at one time a very serious one. The Registrar-General, in his Decennial Supplement (Part III) for the year 1911–20, stated: “The removal from the population of a large proportion of the fittest men caused a reduction in the average standard of fitness among those who remained and hence produced a tendency to increased rates of mortality amongst civilians.” The picture of civilian health in the years of 1914–18 (excluding the influenza epidemic) is not wholly unsatisfactory, but, as Professor Greenwood has said, civilian mortality, when included, makes the excess mortality of that war more costly than the earlier war. On the military side in the 1914–18 war there were organized medical and nursing services, and medical resources such as anaesthesia, aseptic surgery, and other forms of modern therapy unknown in the earlier war. These must have greatly reduced the mortality from wounds and disease.

These remarks are perhaps somewhat discursive. They can be regarded as no more than footnotes to an interesting and informative paper.

MR. G. UDNY YULE: It is always pleasing to find papers in the old volumes of our *Journal* still being cited as of service, and Professor Greenwood has given us a very interesting account of Hodge’s methods, besides adding a parallel estimate of his own for the Four Years war. There are only two points, and those of quite a subsidiary character, on which I should like to comment.

First, if the epithet in the term the "Great War" is held to refer to the magnitude of the calamity, and is to be justified in spite of the judicial *obiter dictum* cited by Professor Greenwood as his text, surely the losses of all nations, and not those of this country alone, must be brought into account? Secondly, I think that the fact of the one war lasting for over twenty years, and the second for only four deserves rather more emphasis. The excess losses in the Napoleonic wars would have averaged some 10,000 a year: the excess losses in the war of 1914-18 reduced to the same population (300,000 to 370,000 in four years) say some 80,000 or 90,000. Very naturally the former would affect the population much less than the latter: the war would "come home" to far fewer people at once, and would be a much smaller feature in correspondence, etc. Not that I should be willing to accept correspondence as good evidence. Certainly in the correspondence I receive during the present war any conclusion from the space occupied by that subject in letters to the "space" occupied by it in the writers' minds would be entirely fallacious. The subject is deliberately avoided. If that is so now, would it not tend to be so during the Napoleonic epoch?

DR. ISSERLIS: Professor Greenwood's interesting comparison of the deaths in the two periods may be summarised in a small table:—

### Deaths

1794-1815	1914-18		
	As recorded		After division by 2·5
Navy:	Navy and Merchant Marine	48,000	
By enemy action .. 6,663	Land Forces .. ..	724,000	
By marine risk, <i>less</i>		772,000	
"peace" totals .. 11,905	<i>Deduct</i> "peace" totals ..	65,000	
By disease etc., <i>less</i>		707,000	
"peace" totals .. 44,662	<i>Deduct</i> 22% for Dominions .. ..	156,000	
63,230		551,000	220,000
Army (similarly calculated) .. .. 143,808			
207,038	Sea passengers and civilians killed in raids ..	8,389	
Civilians:	Under-estimated, say ..	4,111	5,000
By enemy action, <i>i.e.</i> , in privateers .. .. ?		12,500	225,000
By excess of civilian mortality .. .. nil	Excess civilian mortality, not including influenza	187,500	75,000
Say 210,000	Loss of Births, say 500,000 to 700,000	Say 300,000	240,000
Loss of Births .. .. nil			540,000
210,000			

PROFESSOR GREENWOOD, in reply: I sincerely thank the kindly commentators on this old-fashioned paper. I used as divisor 2·5, which is the approximate ratio of the enumerated male population of the United Kingdom in 1911 to that of 1811, because it was in the decade centred on 1811 that the old war was at its height. Had I gone back farther the divisor would have been larger, and so the parity of the military costs brought closer, perhaps too close. I resolutely

refrained from attempting more exact estimates because, as Dr. Stocks points out, there are so many variables when civilian mortality is included that it seemed a waste of labour—which does not much matter—and of paper—which matters a good deal. I confined my attention to our country because I wished to follow Hodge's trail.

Mr. Yule's point about the difference between losses spread over twenty and concentrated within four years is important, but there is another angle from which one may compare the epochs, suggested by his other comment. It is popularly believed, and has, I gather from a review, been confirmed by a recent author, that our ancestors worried very little about the war. Indeed, I remember hearing my father asking my great grandmother (born in 1800) what she remembered of the feelings of people when news came of the Battle of Waterloo. The reply (which disappointed me) was that in *those* days girls of fifteen did not trouble their heads about battles. But the private letters of important people tell a different story. One finds a pessimism hardly equalled even in these times. For example, to us, looking backwards, July 1813 hardly seems a gloomy month. Bonaparte's Russian disaster was known to all, and the news of the Battle of Vittoria had arrived. Here is what Thomas Grenville (an ex-Minister) wrote to his brother Lord Grenville (an ex-Prime Minister):

“ I am no detractor from Lord Wellington, whose talents I am glad to see rewarded by placing him really at the head of our army; but it is quite ridiculous to state him as driving the French out of Spain, when, in truth, they are making no efforts in it, but have withdrawn from thence all the *élite* of their army to carry it into Saxony. It is when the French are in force and in earnest in their Spanish war, that we must see whether he can keep them out of it; Lord Wellington commands now 90,000 men ” (*Dropmore Papers*, X, 348).

The Grenvilles were not cheery souls and, in 1813, probably a little more pessimistic than most; perhaps a little slow to see merit in any government of which they were not members. But a few years earlier most well-informed people were gloomy. *Very* few people of importance doubted the invincibility of the French. One of them, fortunately, was Lord Wellington.

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## ECONOMIC RECONSTRUCTION AFTER THE WAR

A DISCUSSION BEFORE THE ROYAL STATISTICAL SOCIETY, ON MARCH 17TH, 1942,  
the PRESIDENT, SIR WILLIAM BEVERIDGE, K.C.B., in the Chair

Opened by MR. R. G. GLENDAY, M.C., M.A.

HE would be a bold man who ventured at the present stage of the War to prepare a blueprint of the post-war World. Despite the optimism of many would-be planners, it cannot even be assumed that Great Britain, although she finishes the war on the winning side, will be allowed to enjoy anything like the same degree of freedom in the ordering of her own economic destiny and that of her Empire as she did before 1939. Indeed, unless the national contribution to the joint war effort becomes more effective before the critical battle is joined, there is the possibility that she may find herself thrust down among the planned, instead of occupying a prominent seat among the planners. Furthermore, since the present war has not only been far more devastating than the last, but has involved a far more radical destruction of established ways of living and traditional economic systems, one must not be surprised if it takes nearly as long and requires almost as much control to demobilize, reconstruct and revert to a peace-time basis as it did to organize for war. That is to say, the idea that when an armistice is signed it will be possible to put into operation immediately large-scale plans of reconstruction prepared beforehand may easily prove a mirage.

Is there nothing, then, that can usefully be done about post-war economic reconstruction at the present time? By no means. Before post-war reconstruction plans can usefully be prepared, the ground must not only be surveyed afresh, but there must be agreement as to what it is that needs to be planned and how it should be planned. This involves both a fresh analysis and investigation of fact and a re-examination of traditional habits and ideas, if we are not to find that, when the time comes, we have prepared for the wrong kind of peace. And it is to this aspect of post-war economic reconstruction that I propose to confine my observations this afternoon.

To begin with, it is important to realize that the economic site that has to be replanned is not virgin territory; it is already occupied by a variety of economic systems with long past histories of growth and development. These systems were not working well even before the war. So much so, that there must be few optimistic enough to believe that, had we not been plunged into the present war by the frenzy of two desperate men, world trade would have been quietly pursuing a steady upward course towards the goal of universal prosperity and peace. On the contrary, the more one peers below the surface of events in the years between the two wars, whether in Europe, Asia, the Far East or South America, the more one is tempted to agree with the view of a recent writer on Germany: "Strike off this whole war and there would still remain this—progressive, more and more radical revolution. The German, Russian and Italian happenings are the phases of a universal revolutionary upheaval." That revolution has been speeded up by the events of the war.

What contribution, if any, have economic factors made to the driving forces



behind this revolution? The answer given to this question depends largely on the way in which one views economic problems. The two methods most commonly used may, for convenience, be distinguished as the idealistic or traditional economic approach, and the scientific, or practical business approach.

Dealing first with the traditional economic approach it is difficult to deny that implicit behind a large part of the economic thinking of the past two decades, lies the assumption that Universal Free Trade—an imaginary condition that has never existed—should be regarded as the normal and all reality as a deviation from this Utopian prototype.\*

In short, according to this view, the world's economic distress is due to the failure to establish Universal Free Trade. It will be observed that this view is the product, not of analysis, but of aspiration. It has no direct, logical connection with the conditions that created the problem.

It was a desire to emphasize that this method of approach, long since abandoned by natural science, was sterile that made a scientist recently refer to economics as that "mediaeval rubbish taught at our Universities." As a correct appreciation of the distinction between the economic and scientific approaches is vital to the issues that I wish to raise to-day, let me interpolate an explanation.

When a scientist investigates the cause of a particular event, he generally uses the word "cause" in a special and limited sense. Natural science is what Aristotle called a "practical science," valued not for its truth pure and simple, but for its utility, for the "power over nature" it gives us. It deals with something capable of being produced or prevented by human agency. For example, a man who claimed to have discovered the cause of cancer and then explained that this cause was nothing that any doctor could employ to produce or prevent cancer would be dubbed a charlatan. What the human agency does, need not, of course, be the whole "cause" of what happens. Like the turning on of an electric light switch, the human agency may supply only one of the conditions that must be present if the light is to go on. The "cause" of any particular event for any particular person, is the particular condition he is able to produce or prevent. To illustrate by an example taken from R. G. Collingwood: † A car skids while cornering at a certain point, strikes the kerb and turns turtle. From the car-driver's point of view the cause of the accident was cornering too fast, and the lesson is that one must drive more slowly. From the surveyor's point of view the cause was a defect in the surface or camber of the road, and the lesson is that greater care must be taken to make roads skid-proof. From the motor-manufacturer's point of view, the cause was defective design in the car, and the lesson is that one must place the centre of gravity lower.

\* See, for example, Professor Lionel Robbins' well-known defence of *laissez-faire* economics: "The idea of a coordination of human activity by means of a system of impersonal rules, within which what spontaneous relations arise are conducive to mutual benefit, is a conception at least as subtle, at least as ambitious, as the conception of prescribing each action or each type of action by a central planning authority; and it is, perhaps, not less in harmony with the requirements of a spiritually sound society" (*Economic Planning and International Order*, p. 229). As Professor E. H. Carr observes, "it would be equally true, and perhaps equally useful, to say that the constitution of Plato's Republic is at least as subtle, ambitious and satisfying to spiritual requirements as that of any state which has never existed" (*The Twenty Years' Crises*, p. 10).

† *Essay on Metaphysics*, pp. 304–307.

If the three parties concerned take these three lessons respectively to heart, accidents will become rarer. Obviously, for a person who is not in a position to produce or prevent any of its conditions, a motor accident can have no "cause" in this sense at all. The traditional economist may be likened to the managing director of the insurance company who said that his wide experience of motor accidents had convinced him that the cause of all accidents was people driving too fast. From the strictly scientific point of view this statement has no meaning. But, as Collingwood observes, "one could expect nothing better from a man whose only practical concern with these affairs was limited to paying for them."

When, therefore, the question is posed: what is the cause—in this scientific sense—of the world's present economic ill-health, the practical man will not be satisfied with the economist's explanation that it is all due to the business man's stupidity and wickedness. These have prevented him from conforming to certain theoretical economic laws. From a purely intellectual or ethical standpoint, this explanation may be quite satisfactory, but not, necessarily, from the point of view of being practically helpful.

The scientist, for example, will still deem it worth while to make a careful examination of the conditions of the environment within which the business man operates, in order to find out whether there are any factors in it which, when varied, have an influence on the occurrence of these so-called economic mistakes. Let me take as an illustration the perennial controversy of Free Trade Versus Protection. It is almost impossible to pick up an article on post-war economic reconstruction, without finding a reference to the desirability of getting rid of what are termed the *evils* of exchange manipulation, high tariffs, import and export quotas, monopoly controls and the like. The suggestion underlying these criticisms is that the adoption of these restrictive devices has primarily been the result of the ignorance or wickedness, or both, of business individuals and national governments. Clearly, this is not the whole explanation. Otherwise, how comes it that a century ago, when British business men were surely just as wicked and selfish—and far more ignorant—than they are to-day, we find them combining to recommend a policy precisely opposite to that which so many of them have been urging in recent years. Listen to what the Sir Ernest Cassel Reader of Commerce in the University of London has to say on this historical aspect:

"The great majority of economists, both in Great Britain and in the world as a whole, were and are in favour of free trade. Again and again international conferences have urged reductions in tariff barriers. Yet free trade would almost certainly have come in Great Britain in the nineteenth century if no abstract reasoning had ever been advanced in its favour, and all the economists—who, after all, are the specialists in this subject—were quite powerless to stem the tide of protection during and after 1931." \*

"It is a sad thought," he concludes. It is, of course, nothing of the kind, only that the economist has been behaving like the man who, in considering the problem of the baby and the bath water, has overlooked the fact that in the course of time something may happen to the bath. What has been overlooked is that the "bath," that is, the economic environment in which the British business man conducts his operations, has changed very considerably in the century which has elapsed since the 1840's.

\* F. Benham, *Great Britain under Protection*.

It is these changes in the business environment which, I urge, must be scientifically analysed and understood before any useful work can be done on planning for post-war reconstruction. I suggest, for example, that a factual examination of the condition of Britain's economic environment during the two pre-war decades, would make it clear beyond doubt that the change-over from Free Trade to Protection in 1931 was not primarily due to the immoral choice of wilful men or national governments, but was largely forced upon them by influences outside their individual control. More than this, the adoption of a tariff barrier was, in a sense, only a supplementary feature of a far more important major change, namely the decision, taken in connection with the breakdown of the international gold standard, that as a nation Britain could not, in future, in fairness to her people, allow her domestic, credit and employment policies again to become the playthings of international speculation. In short, the old system refused to work any longer so we were compelled to try something different.

That the above is something more than a partisan defence of the business point of view is made clear in a recent paper by Sir Hubert Henderson. He writes:

"The essential points are that the multiplication of trade barriers in the 1930's sprang largely from the collapse of the international gold standard, and that that collapse cannot reasonably be attributed to any self-regarding act of national policy. It represented the breakdown of an international system under the pressure of market forces which it was not strong enough to withstand. The fact that the system broke down in this way, only a few years after it had been laboriously reconstructed, has a profound significance which facile plans for post-war reconstruction are far too apt to ignore. It requires, as it seems to me, an abnormally large dose of the doctrinaire's traditional imperviousness to realities to suggest that the breakdown might have been averted if the world's tariffs had been lower in the 1920's."

Let us pursue the matter further and enquire: what were the environmental forces which helped to overthrow the international system built up so laboriously over the nineteenth century? Obviously, unless and until we have taken a measure of the strength of these forces, it is impossible to determine whether it is practicable to restore an international system of any kind at all and, if not, what kinds of alternatives are worthy of experimental trial.

The best I can hope to do, in the limited time at my disposal, is to indicate certain outstanding environmental factors that must be taken into account in making a diagnosis.

It was, I submit, because we failed to make a diagnosis of this *kind* after the last war, that it took our economists until 1931—that is, over ten years—to realise that they had been striving to plan for a world environment that had ceased to exist.

Three factors which, in my judgment, have played a major part in precipitating the economic revolution, of which the present war should, I suggest, be regarded as part, are: (1) the closing of the age of territorial expansion: (2) the slowing down in the rate of population growth in the more developed and wealthier countries coupled with continuing expansion in the less mature, and (3) the failure to appreciate that, even though an economic system may not be consciously planned, it still must in its process of growth conform to certain rules of order and structure if it is to avoid breakdown. In particular,

the rates of growth of its separate parts must be kept in proper relation to one another, and for every structure there will be a most convenient size.

Throughout the nineteenth century and the early decades of the twentieth economic expansion relied largely on the occupation of new areas of virgin territory by rapidly growing populations.

The expansion of Europe into fresh overseas territory came to an abrupt stop with the outbreak of the Great War in 1914. There was a mild resumption of both migration and foreign investment in the immediate post-war years, but nothing like on the pre-war scale: indeed, the outstanding feature of this second period was the growing restrictions on immigration by the previous emigrant-absorbing countries and a closing down of avenues of foreign investment of the old type. Sir Percy Bates, Chairman of the Cunard Company, in a recent speech, gave a picturesque description of this change, when he alleged that "but for these restrictions there would by 1939 have been some 20,000,000 fewer people in Europe." He may have exaggerated when he suggested that had they been allowed to go overseas "there might not have been enough steam for Hitler to cook up this war," but it is certain that obstructions to the free flow of migrants constituted one of the major disturbing elements in the pre-war European economic situation. The basic cause of these restrictions on emigration was the fact that the main undeveloped areas overseas available for large-scale settlement, had been occupied, so that emigration, especially if allowed to continue at the accelerated rate which seemed likely after the last war, would have led to a reduction in the standard of living of those already settled there. Just as, in the same way, Britain would have become a vast slum had not steps been taken by individuals through the practice of birth control, and in other ways, to check the rate of internal population growth after the 1870's.

In fact, there seems little reason to doubt that these two sets of developments were causally connected; for the slowing down in the rate of population growth of the more developed areas in Northern and Western Europe affected the rate of growth of demand for overseas products, notably food, while the restrictions on emigration which checked the outflow of surplus populations from the less developed areas, especially in the mid-Eastern European peasant countries—whose populations have, partly for this reason, increased by nearly twenty-five per cent. in the past twenty years—caused not only congestion in Europe but also a decline in the overseas demand for European products.

The following table, computed from Kuczynski's *The Balance of Births and Deaths*, gives a picture of the decline in the leading countries of North and Western Europe, including the United Kingdom and the Irish Free State and Germany:

<i>Decade.</i>	<i>Increase.</i>
1883-93 . . . . .	10,290,000
1893-1903 . . . . .	14,950,000
1903-13 . . . . .	14,510,000
War Period . . . . .	—
1926-36 . . . . .	9,468,000

For Great Britain the change was from an increase of nearly 4,000,000 a decade before the last war to under two millions afterwards. After the present

war her population will probably be more or less stationary with a tendency to decline in the future.

This decline in rate of growth of numbers reacted on the economic prosperity of the overseas agricultural countries which were continuing to expand output on the assumption that the pre-1914 increase in the external demand for their products would continue to grow at least at the old rate.

The position in the immediate pre-war period was summed up as follows in the memorandum from which I have just quoted. "As a broad generalization it is fair to say that until 1914 the world demand for most agricultural commodities increased more rapidly than could be met, under existing conditions of agricultural technique, from the existing areas of supply; so that there was a constant tendency to open up new areas of production. Under these conditions, agricultural depressions, though they might be severe, were only temporary interruptions in a long-run process of expansion. But in the nineteen-thirties it became apparent, not only that new productive areas were no longer needed, but that the output of most agricultural commodities of which the existing areas were capable was far in excess of the world's demand. . . . The surplus of agricultural capacity was a major influence in causing the collapse of the gold standard. It also entailed an increase of agrarian protection in food-importing countries. This was hardly less inevitable. In all countries, agriculture is an important interest, commanding great political influence; and no Government could afford to stand by and see its agriculture ruined when it was well within its power to avert this ruin. . . . These measures are open in detail to various criticisms, but those who condemn them comprehensively from a lofty international standpoint should explain whether they would really have been prepared to see the virtual disappearance of arable cultivation in Great Britain, or a further depression of the agricultural labourer's standard of life."

But territorial expansion, or "extensive" investment as it is sometimes called, was not the only source from which the economic system acquired its impulse to expand. Almost as important an element was what is sometimes referred to as "intensive" investment, that is, the development of new inventions designed to enable goods to be made and distributed more quickly and so more cheaply, and thereby the standard of living of the population to be catered for to be raised.

What are the prospects of new major inventions of this latter kind? The future is hidden from us. But, bearing in mind the many years of gestation required to bring a new major invention to birth in the commercial sense, the omens are not particularly propitious.

The fact that a full decade of relative stagnation and persisting unemployment succeeded the culmination in 1929, in the United States, of the wave of technological changes based on electricity and the motor-car suggests that it cannot be taken for granted that new avenues of employment in British industry will automatically be forthcoming to fill the gap, once the more immediate needs of physical reconstruction have been met after the war, especially as our own version of the American wave of 1924-29 seems to have culminated about 1937.

Remember, it is not merely a question of creating new avenues of employment, but of creating them *fast enough* to absorb those thrown out of work by technological developments of a labour-saving kind, such as have been widespread as a result of war-time reorganization.

The long-run history of economic evolution in the more developed countries may be summarized as follows: To begin with, agriculture provides occupations for the bulk of the population; next, industry becomes the main expanding avenue for new jobs; last of all, home service occupations, including building, distribution and entertainment, take the lead. By the outbreak of the present war, it was clear that in Britain even this last avenue was nearing saturation point if, indeed, it had not already passed beyond it.

Those who are accustomed to assume that *industrial* occupations can automatically be expected to provide expanding avenues of employment after the war, should ponder over the position in that home of invention, the United States. The figures show that an expansion in annual production between 1920 and 1935 of some 39 per cent. was associated with a decline in industrial employment of some 18 per cent. Likewise, those who believe that local industrialization in countries overseas need not permanently harm our export trade, should remember that the expansion of employment in Britain in recent years has been into *home service* occupations rather than into the manufacture of new *international commodities*. Export expansion has been in machines rather than in final consumption goods.

The above briefly summarizes the behaviour of some of the leading factors which I suggest have been in part responsible for setting in train the vicious circle of contraction which led to the growing imposition of restrictions on the flow of output in general, and for which neither the individual business man nor the individual national government can be blamed.

What makes it so difficult to deal with the situation under the present system is not, as is so widely alleged, that the means of production are in private hands, or that production is for profit instead of for use. For the substitution of State ownership for private ownership and the abolition of private profit would leave the central problem substantially untouched. Basically, the source of the hold-up is the fact that our present system relies for the raising of the *communal* standard of living upon a number of separate *individual* producers each of which increases his own individual output of a *single* commodity or part of a commodity or small group of commodities. This is what is meant when it is said that our present economic system has increased the wealth of its members by sub-dividing and specializing the work of producing their joint communal needs. Now in the course of this process, if the individual (or country of which he is a member) begins to find that other producers are not prepared to offer him the *other* goods he needs in exchange for the surpluses he produces over and above his own requirements of the *particular* commodity on whose production he concentrates his efforts, he will stop producing further. Furthermore, if he does not take steps to protect the exchange price of the article he produces against price-cutting he may find his standard of living not only ceasing to rise the harder he works, but perhaps even beginning to fall. It is all very well to tell him that there are people in the world prepared to accept his surplus output free gratis as a present. His own view will be that he has been bilked, and he will resolve to take steps to prevent this from happening again in the future. Consider the following:—

It is said—and the figures are accurate enough for the purposes of illustration—that before the present war the labour of a farmer in New Zealand was sufficient to feed forty people, the labour of a farmer in Australia and Canada was able to feed about twenty people, while the labour of a farmer

in this country was, on the average, capable of feeding about eight people, and the labour of a farmer in Mid-Eastern Europe was not sufficient to feed his own family at the same level of adequacy. How are we to reconcile the "haves" and "have-nots" in a world in which populations in relation to natural resources are distributed in this unequal manner? I do not pretend to know the answer. All that I do insist is that anyone who alleges that the way out is a world redistribution of population and occupations should be compelled to particularize in detail what he intends should be done. Vague theories or vain dreams will not do. How can, for example, the surplus food capacity of, say, New Zealand, be shared with the peasants of Mid-Eastern Europe? If this cannot be arranged, how else are the producers of surpluses of food and other articles in the same condition not only to maintain, but to prevent from deteriorating, their standards of living, except by applying a brake on the production machine and protecting prices? Or is a forcible redistribution of either population or food the answer?

Bear in mind that I have dealt with only a section of the international field, but with enough of it, I hope, to indicate that it raises issues which take us right out of the realm of traditional political controversy. In facing these issues, as face them we must, let us not forget that almost every month that passes sees something being done somewhere as a result of the war that modifies the situation in one respect or another. Our post-war export problem, for example, becomes daily more intractable—that is, more difficult to solve without some drastic limitation of imports—as our losses of overseas assets pile up on the one hand, and the speeding up of industrialization in our previous overseas markets gathers momentum on the other. This is not the whole story. We are in addition losing control of certain of our overseas lines of communication and raw material supplies and our pre-war international economic links are being severed in other directions also.

Time prevents me from dealing in detail with our more domestic problems, but here again the war has accelerated existing long-run tendencies. For example, already for good or ill unregulated control by private individuals in many of our basic services and industries has gone never to return: the same is true of parts of our present banking machinery and commerce. The difficulty, as in the case of our current war effort, is to find a satisfactory way of combining the benefits of individual leadership with communal service. If the suggestions made by our President, Sir William Beveridge, in to-day's *Times* were put into operation we should, by the time the war is over, have taken a major step towards its solution.

In sum, the war is already well on the way to transforming our old pre-war economic structure into something new. It is part of the revolution.

It has been said that the settlement that was put on paper at Versailles was in all its fundamental aspects made during the war itself, and not at the Conference. This will be even truer of the settlement after the present war. We are making the shape of things to come, now—literally. Once this is understood, the imperative need of considering post-war problems, even at a time of major concentration on the effort of war, is apparent to all.

MR. HENRY CLAY : I think that one effect of the war will be, as after the last war, to intensify and accelerate tendencies operative before the war; I refer particularly to the decline in exports. One third [of British industry

worked for export before the last war. This fell to about 15 per cent. by 1938. I do not agree that inefficiency of the export industries was the explanation. Cotton, shipbuilding, coal were largely controlled by the same men in the expansion before and the decline after the war. The most obvious influence on the fortunes of industries dependent on exports is the great increase in the height and extension of protective tariffs after the last war. The grant of fiscal autonomy to India was a striking example of this and of the way in which British exports were prevented, step by step, from getting round barriers to direct trade, by triangular trade. The effect of these changes is seen in the creation of depressed or special areas. In this country and in manufacturing redundancy in the world as a whole, accompanied by the correlative of agricultural surpluses, high taxation prevented the development of alternative export industries to remedy the contraction of those which had lost external markets. The adaptability of nineteenth-century industry was due in large measure to the finance always available in industrial areas from current profits. High taxation killed this source, and no alternative source of financing such changes was available.

The second cause of the relative decline of the importance of exports was the shift of industry to production for the home market. The industrial depression between the two wars had as its correlative a depressed level of agricultural prices. Cheap food released income for other purposes and provided the inducement to industry to redirect itself to satisfying other home market needs.

I apologize for the length of this reference to pre-war developments. I will atone by being brief in my attempt to draw the moral for the post-war world. It seems to me that we may expect a repetition of the fate which faced our export industries after the last war. The war has enormously extended and accelerated industrial development in countries which formerly drew industrial products from this country, and this effect of the war is likely to be confirmed by protection after the war. The present tendency in quarters which resist these protective tendencies are directed rather to eliminating certain forms and incidents of protection—quantitative restriction of imports, bilateral trade agreements, mutual preferences—than to reducing the absolute height and extent of protective tariffs. The effect is likely to be the same as after the last war—first to deprive existing industries of existing markets and second to make it more difficult to turn the flank of a high tariff on things we make by three-cornered or four-cornered trade. The remaining gaps in the dyke which excludes the flood of British exports are being closed. Having lost our preferential position in the Colonies, for example, we shall be unable to secure command of exports to others which are not excluded from the American and other protected markets, as our own manufactured products virtually are. Some compensation may be offered by large capital expenditure in reparation of war damage or new development providing a market for our exports; but there is no reason to suppose that the purchasing power created by this capital expenditure would be directed to purchasing British exports rather than exports from Japan, India or Germany. We may be able to find outlets for capital exports which will employ our equipment industries; but an export of capital obviously does nothing to redress an adverse balance on current and capital account taken together.

The shift from export markets to the home market is likely, therefore, to be intensified. There were sufficient deterrents against exports before the war—defaults, currency depreciation, excessive competition; a good deal of the pres-



sure to export was largely a matter of habit, which the war may have broken. The pressure of taxation on the supply of capital to finance adaptation to changed needs is far heavier than twenty years ago. Can we, however, allow our exports to fall much lower than they had fallen before the war? We need a high minimum of imports to meet essential needs, and the contribution to paying for them derived from our invisible exports will have been substantially reduced by the war. We are living not uncomfortably on a very much contracted volume of imports, if imports of war requirements are left out of account. We have for years been supplementing our exports by sale of overseas assets, and we still have a good many of these left which would be realized automatically by sinking fund repayments and maturities. The fall in our exports may be checked if, as many people expect, exchange control is kept on to prevent an export of capital, even though it be removed from current transactions. Countries which supply us with our imports and are paid in sterling will then have only two alternatives—to take our exports or to make us a loan of the proceeds of their exports to us. But it seems certain that the difficulties of our post-war balance of payments will be increased and will lend support to the demand for protection of the old-fashioned type, a demand which followed the last war and is likely to be intensified after this war. There would be a real need of restricting imports if we can devise no alternative method of balancing our international accounts, and the straightforward protectionist tariff seems to be the method of restriction to which least political objection, however irrational it may be, is raised. While this increase in protection will stimulate employment in the home market industries, it will, however, do nothing for the export industries which were depressed before the war, and it would seem wise to expect that the same areas will be depressed for the same reasons after the war as before.

PROFESSOR A. G. B. FISHER : I listened to Mr. Glenday with some expectation, especially after he had used the analogy of the man looking for a cure for cancer. I hoped that we might be told the correct treatment for the rather complex cancers he had been describing. But the main impression he gave was that we were in, and likely to remain in, a very bad situation, and must not do the things we had done in the past. What we had to do was left somewhat obscure.

I do not know whether it is idealistic or scientific, but it seems to me to be sensible to approach this sort of problem in a very elementary way along the following lines. We have at our disposal, if we think of a particular country or of the world as a whole, certain productive resources—human capacity, capital, and other things. At the end of the war we shall still have resources extraordinarily varied and with great inherent capacity for production if properly treated. The next step, I suggest, is to consider broadly what we want to get out of those resources, and I am still simple-minded enough to suppose that the proper end of economic policy is to get as high a standard of living as the available resources make possible.

I suggest that before any discussion of the actual structure of the economic system takes place, or any sort of planning is considered, it will be advantageous to examine the kind of changes involved in the attainment of the ends which we set before ourselves. We can then think more clearly about the actual pieces of economic or commercial machinery that we are going to adopt as appropriate for our ends. In doing this, undoubtedly many of Mr. Glenday's

points ought to be very much in our minds. The problem in front of us will obviously be very different in many important respects from the problem of the last twenty years or of the last century, or even of the last thousand years. But we are in some danger of exaggerating the extent to which the fundamental requirements of the situation have in fact changed or are changing at the present time. Indeed, if the experience of the past had not some positive value for us—apart from its negative value in showing us what not to do—then the kind of analysis which Mr. Glenday has suggested would be much less useful than it is. But it is not very satisfactory simply to say that there were certain obstacles in the way of doing certain things. That these obstacles were irremovable is not an axiom to be accepted without further question.

While I agree that there is no very useful end likely to be served by speaking harshly of the alleged weakness or ignorance of other people, it is just conceivable, it seems to me, that governments and other human groupings have made rather serious mistakes in the past. It is rather difficult, in the midst of such a conflict, to take an opposite view, but it is useful, even essential, that we should examine carefully the more fundamental causes which have diverted development along what many people think are the wrong lines in the past. It is not sufficient, however, simply to analyse those causes unless we are prepared to go further and consider to what extent some at any rate, if not all of them, may be removable.

Mr. Glenday gave a picture of the past changes in the various types of production which have been suitable to the circumstances of varying periods, and he suggested that one reason why we had done rather badly after the last war was because we did not pay attention to the necessity for keeping the rates of growth between the different parts of our economic organization in their appropriate relations. That is, I think, an extremely important point, which deserves much more careful examination, both statistically and otherwise, than it has commonly received in the past.

But the practical importance of the point clearly turns on what the appropriate relations are, and it does not seem unreasonable to suppose that one further reason why we did rather badly after the last war was because people *did* attempt to keep certain relations between certain types of production which were appropriate in the past, but were not so any longer. That suggests that a purely scientific analysis of the developments of the last twenty years and of the present period ought to have included some investigation into monopoly and quasi-monopoly developments which by their nature tend to crystallize certain relationships between certain types of production, even though they are no longer appropriate to the changing conditions of a later date.

I have not time to tie up adequately the points which I have mentioned, but will conclude by emphasizing that in making a plea for flexibility in the relations between different parts of the economic structure, one is not pleading for something which is quite outside our ordinary experience. I think that one of the most astonishing things in the history of the last twenty years, and one which would reward careful examination, is the extent to which the changes of the kind I have in mind did in fact occur during that period and, on the whole, with advantageous results for all the individuals and groups concerned. The main difficulty was not that the changes did not occur, but that they did not occur on a sufficient scale or sufficiently rapidly.

SIR WILLIAM BEVERIDGE (speaking from the Chair) : In considering problems

of post-war reconstruction I have found it convenient to make an elementary practical distinction between the planning of those things which are within the power of the Government of this country and those which are not but would require the assent of other friendly nations. Mr. Glenday, Mr. Clay, and, to a less extent, Professor Fisher, have devoted themselves mainly to the latter group of questions, and have adopted, perhaps not unnaturally, a pessimistic outlook.

I want to mention one or two things which could and should be done for economic reconstruction and which do not need the assent of any other friendly nation. I assume that our fate will not be controlled after this war by an unrelenting enemy and that our victory will enable us to settle our own affairs. If this country is in that position, I see no reason for believing that we must inevitably, even after the transitional difficulties, be much poorer than before the war. Science will continue to advance, and business men or the State will continue to apply its discoveries. The fact that export trade is already so small means relatively less suffering by its further contraction.

It is true that there will be transitional difficulties. It will be necessary to work a little harder, at first, because much of what our fathers saved will have been lost. But it will be easy to work harder. Therefore I assume that the nation will not be much poorer after this war than it was before the outbreak of war; it may not be any poorer; it may quite soon be richer.

On this assumption there are two things which could be undertaken. The first is to abolish want, by which I mean want as it is defined in the social surveys of poverty made of recent years for so many of our great cities. The authors of these surveys have set up standards of what was required for subsistence and have estimated what part of the population is above or below those standards. The survey of this kind made in London in 1928 or 1929 showed that in East London the total income of the working-classes who were above the minimum standard was thirty times as great as the total deficiency of total income of those who were below; so that if one-thirtieth of the excess could be transferred from the people above to the people below there would be no want. Taking a higher standard, such as that used by Mr. Rowntree for York in 1926, it was found that in the working-class population investigated, the total excess of the incomes above the standard was eight times the total deficiency of the incomes below the standard. Thus, by a mere redistribution of the income of the working-classes in a pre-war year, without touching any of the "idle rich," want could be abolished. I do not suggest that it should be done in that way; I am concerned only to point out that the money was there to do it.

These surveys showed that poverty is not due to lack of total income, it is not really even due to an excessive amount of the total income going to the rich. It is due to two causes only: to interruption of earnings brought about by unemployment, sickness, old age, or death of the breadwinner and similar causes, and to large families. The first cause could be dealt with by an efficient and complete system of social insurance, the second by family allowances. Abolition of want as defined by the social surveys is simply a question of slightly redistributing income. I do not say that if that were done all desires would or should be satisfied, only that want as defined by social surveys could be abolished.

With regard to the abolition of want I will not say anything further, except that I see no reason why it should not be attained. I will come to the second thing I wish to see abolished, namely, urban congestion. This problem of the perpetual growth of the large cities is to many minds as great a social evil as

unemployment. It produces overcrowding, bad housing, enormous waste of life and energy in travelling to and from work. I believe that it is within our power to cure this evil—without worrying about what America or Russia thinks—by a planned redistribution of population and industry. But to do this would mean that we should have to get over a great many very well-entrenched vested interests.

Both the objects I have mentioned are within our power to attain unless the nation is much poorer after this war than it was before, and there is no reason for supposing that that will be the case. These two things could be done, broadly, on three conditions. The first is that we win the war and make such a reasonable contribution towards winning it, that the rest of the world will be friendly. Although, with many others, I think some changes might with advantage be made in the management of the war, I have no reason to doubt that we can be victorious if we choose. The second condition is that the nation shall will these changes sufficiently to override the various vested interests. The third is that the changes shall be adequately planned.

Apart from the two points which I have named, there are many much harder economic and reconstruction problems to be solved—including the problem of the trade cycle. I agree also with Mr. Glenday that the transition problems will be harder to deal with at the end of this war than they were at the end of the last, because the country (even if there is no more destruction) has been much more disturbed. But I should like to make as my contribution to this general discussion of reconstruction problems, the suggestion that we ought to pay at least as much attention to problems whose solution is within our power as to those whose solution requires an international agreement. I should like to see the Government announce that it could do the two things which I have suggested, that it had plans for them; it might then say to the country, "You need not worry about these two things; all you have to do is to win the war." I hope also that the Government will announce loudly and clearly that it is paying attention to problems not necessarily within its power to solve but to which it will be able to contribute in combination with others.

THE HON. GEORGE PEEL asked if some reference should not be made to the policy of economic reconstruction which had been announced in the last few days by the British Government and by the Government of the United States. The White Paper of February 23rd last set forth their plan, chiefly in Article 7, and the Government's views were not in accord with what had been said to-day. Article 7 declared that the British and United States Governments would unburden commerce between the two countries, and in the second place that all discriminatory tariffs would be abolished—the opposite of the policy of Ottawa. Thirdly, trade barriers generally were to be put down. It seemed to him that this was a great policy of economic reconstruction which should be referred to.

SIR GWILYM GIBBON was inclined to say "a plague on all your theories." What was the use of talking about free trade now or in the future? We should have to follow our time-honoured practice of suiting our measures to the particular circumstances. He entirely agreed with the President that there was no reason why this country should be any poorer within seven or eight years after the end of the war. There were untold possibilities of further scientific advances. There would be big problems to be faced immediately after the war; mistakes

were made last time, but they could do better although they would not do so by talking generalities. There would be a spurt, then a bad period, afterwards a reasonable measure of prosperity if we went about the business in a sensible way, with the usual ups and downs. What had to be undertaken was not the formulation of theories but the preparation of a real blue print, a provisional blue print. It had to be remembered that all good statesmanship was empirical.

He joined issue with the President as to the large towns. A good deal could be done; in fact all the big towns needed transformation, but that was by the way. All he would urge was that they should cease talking generalities and theories and get down to actual concrete proposals as far as possible, and spend their time in trying to thrash them out.

DR. R. G. HAWTREY called attention to the fundamental importance of distinguishing the immediate problems of the post-war situation from the ultimate problems. Mr. Glenday was dealing mainly with the ultimate problems, and he did not think they could be dealt with intelligibly without some consideration of the immediate problems.

One of the fundamental facts would be that in this and all other countries in the world there would be many people with acquired faculties in the use of appliances for satisfying economic needs, and there would be at the same time an intense scarcity of goods, both consumption goods and instrumental goods. There would be an intense demand for production of all kinds, and alongside it there would be a very dangerous monetary situation, an enormous accumulation of idle money in the hands of people who wanted to spend it on making good these deficiencies. The very first problem with which we should be confronted would be how to prevent a complete monetary breakdown. It must be assumed that that would be successfully dealt with; if unsuccessfully, money would be depreciated to nothing in a number of countries, with all the disastrous consequences entailed.

The people, with their acquired skill and the appliances needed for their economic activity, had to be brought into contact with each other and with the demand. A Government could do very much to facilitate this process. Instead of thinking in terms of exports or outlets, the world should think in terms of what facilities they had for satisfying needs, and the need for organizing all those facilities, human and material, as quickly as possible.

To some extent the people would solve the problem themselves; they would want to go back to the same vocations as before the war, and that should, in the first instance, be the method mainly to be relied upon to bring order out of chaos. It would be an impossible task to start planning and disciplining people from above; and they should be allowed to sort themselves out as far as possible.

This meant that at first we must return to the system which Mr. Glenday swept aside. When he spoke of the idealism of economists and their advocacy of free trade, the speaker did not suppose he meant merely an abolition of protective tariffs, but a reliance upon demand and profit as the motives for economic action. Fundamentally he thought that such reliance would be inevitable.

Whether that situation would subsequently call for further change it was very difficult to foresee; there were signs in the pre-war world that the economic system was undergoing a fundamental change, but he was not sure that those signs were not due to a pathological condition which could have been avoided. Sir William Beveridge referred to the trade cycle as a thing for which he could

not see a remedy; but he (Dr. Hawtrey) maintained that there was no trade cycle in the years between the two wars. What happened was that on several critical occasions the monetary authorities deliberately proceeded to restrict the flow of money. One of the requirements for a smooth return to economic activity after the war would be that the monetary system should not be allowed to get out of hand. An inordinate inflation must not arise, nor must an unnecessary deflation be inflicted on any one country or on the world. What happened after the last war was that inflation was let loose, and, when it had gone farther than anybody was willing to tolerate, it was reversed by an unprecedented deflation and an epidemic of unemployment. That kind of thing must be avoided at all costs. The essential condition was to prevent the inflation arising in the first instance so that the need to correct it did not arise in the future.

MR. STANLEY JEVONS felt bound to join issue with Mr. Glenday when he said he found no place for government ownership and enterprise in the post-war reconstruction. His personal analysis was that we were witnessing the end of the profit motive as a useful instrument for mankind's progress. He thought that the classical economists were perfectly right when they viewed free competition and the profit motive as greatly beneficial to mankind, but that was based upon the assumption that producers would seek to meet competition by reducing the cost of production. This did occur at that time; but with increasing competition the producers had found it difficult to reduce costs any further, and had sought other ways of increasing their profits, principally advertising. That had tended to produce enormous profits for certain firms. In addition, all kinds of ancillary services, such as delivery to consumers, had been introduced. As an illustration of how superfluous and costly such service might become he would mention that within a radius of a quarter of a mile of his home in South Hampstead some years ago he had counted 135 different laundries which delivered and collected goods.\* Anything which raised costs, whether advertising, trade union combination, or employers' combination, tended to limit the quantity of goods consumed. The lower the price, of course, the greater would be the consumption of goods.

There were other causes of high costs of production, perhaps not quite so important; but he must refer to the restrictions of trade which had tended to be introduced by price rings in nearly all the great industries. They were an established feature of the present century and he attributed very largely to that, and to the growth of trade union combination, the growth of unemployment. Not entirely, because we had also fallen behind technically in this country. These price rings and restrictions had tended to take the place, for the purpose of maintaining profits, of the adoption of the latest technical methods, which were widespread in America and Germany and had even been adopted in France and Japan, but not here.

The remedy was that the Government itself must be the enterpriser, first of all in the basic industries; later, there should be a whole new system of distribution based entirely upon planning. The best illustration of how this would work was the points rationing scheme, the points functioning as credit units in place of money. There would then be distribution according to the people's

\* A list of the names on the laundry vans seen was kept, to avoid double counting.  
—H. S. J.

desires of all the goods produced in the country, divided out as they were needed.

If that was thought out it would be seen that it was an economic system which was perfectly practicable with the present-day capacity for organization and planning, and with the possibilities of statistical control which had been developed during the present century.

MR. E. R. BRANSBY said that as a layman on this subject he had been depressed by much of what had been said about the contraction of export markets and the effect on world commerce. One thing appeared to him as fundamental: there was on one hand throughout the world a tremendous under-consumption of all goods, and on the other a productive capacity which in the past had not been fully used. For example, it was abundantly clear that if everybody had a proper diet agricultural production would need to be increased enormously. The same principle of under-consumption hand in hand with unused productive capacity, applied to housing, clothing and all other consumption goods. The Chairman had spoken of the elimination of want from this country. He was particularly depressed because no suggestion had been made for the elimination of want throughout the world for the setting up of some central planning authority which would survey the needs of mankind and plan the future of the world so that these needs could be met. If this were accomplished there would be no need to fear lack of work for the productive industries—on the contrary, productive capacity would have to be increased to meet the demand.

The following contribution was received in writing :—

MR. J. E. ALLEN : I am sorry not to be present for the discussion opened by Mr. Glenday. No doubt other speakers will have drawn attention to the unprecedented amount of reconstruction in Europe, the Far East and North Africa which will be required after the war. This, added to the replacement of depleted stocks and the satisfaction of postponed wants, will cause a great but temporary boom after the war. Human wants are insatiable, but the means of paying for their satisfaction are limited, and this may prove the chief economic problem after the war. The luxuries of one generation become the necessities of the next. Possibly two-thirds of the population of Western Europe, four-fifths in Eastern Europe and nine-tenths in Asia have been living, even before the war, on a standard well below that of the British Medical Association and below that of an unemployed family in this country.

In many parts of the world I see scope for large schemes of profitable land-reclamation. We hear of heavy rain impeding military operations in North Africa, which I imagined to be desert. No area need be a desert if it has heavy rain at any time of the year. Other countries, such as China, suffer in the opposite way—from floods—and here the need is for big enterprises of the Great Boulder Dam type, which would at once (1) prevent floods, (2) provide hydro-electric power, and (3) furnish ample supplies of fresh water for irrigation and domestic use.

For years past we have all been living on capital in the sense that we have been exhausting the mineral resources of this planet—iron and coal, oil, copper, tin and so on—which can never be replaced. The exhaustion has been accelerated during the war. Again, we have been cutting down our forests and exposing the soil to denudation, in fact we have been creating deserts. There is thus

plenty of work to be done when the war comes to an end. How it is to be planned and financed is beyond my capacity to devise.

The vote of thanks to Mr. Glenday was put from the Chair and was carried unanimously.

MR. GLENDAY, in reply: I must confess to a feeling of uneasiness about most of the public discussions on reconstruction. I seem to detect a complacency—an assumption that fundamentally all is still well—unduly reminiscent of the attitude in which we approached the present war. To-day's discussion has been no exception. Apart from Mr. Henry Clay, and perhaps Mr. J. E. Allen, most of the contributors to the discussion have left me with the impression that they believe that, as a nation, we can engage in one of the most destructive wars in history, lose the bulk of our foreign movable assets, make evident to the world at large our inability to defend our more permanent overseas assets—that is, our Empire—and sink as a fighting nation to the level of a second-class power, and yet expect to continue to enjoy not only as high a standard of living as before the war, but if we are to believe Sir William Beveridge, “may quite soon be richer.”

How is this miracle of wishful thinking to be achieved? Sir William Beveridge's proposals, if I understand them aright, are a new blend of that old panacea of decadent empires, *panem et circenses*. He was unable to suggest a cure either for unemployment or the trade cycle. There could, we learn, be a redistribution of income, not only between rich and poor, but also between less poor and very poor. Then we are to abolish urban congestion by a planned redistribution of population and industry. How simple this sounds! But how is the trick to be done? He hinted, as did also Professor Fisher, though neither expressly stated it—that we should in effect copy the prescription of the ancient Egyptians: vast gangs of “serf”—but called “free”—labour organized, not to build pyramids for kings, but new towns and industrial areas for their fellow men. But what is to happen after we have driven people out of their existing homes and familiar surroundings and re-located them in the “garden cities” of our planners?

The common man demands freedom to do as he pleases, a congenial job, opportunity for cheerful relaxation, and, if he feels like it, for raising himself and his family to a higher standard of life. After all, he has been told that he is fighting for freedom and democracy, not for dictatorship and control. Given that by eliminating the rich and by heavy taxation, we are able to provide everyone with a reasonable house and a basic ration of food and clothing—a programme which the facts adduced by Professor Clay suggest will not be any too easy to fulfil—how are 46,000,000 people to be provided with employment and a worth-while existence on this tiny island? That is the crux of the problem. Remember that if the evidence of the pre-war period is any guide, once our rebuilding programme is completed, the prospects are, from the employment point of view, far from glowing. Industry proper certainly shows no signs of offering expanding avenues. Quite the contrary. Urban services and distribution, which took up so much of the slack before the war, are almost equally discouraging, unless Sir William Beveridge's ration is to be an iron ration. For even before the war, rising distribution and transport charges were beginning to check consumption. The problem is not made easier by the circumstance



that our total population is likely to decline. This means progressively less new capital development work, more old people and unemployed dependants to be supported by those at work.

Perhaps the labour gangs of our planners will be turned to making plant and equipment to be given away free to the less developed areas of the world. Thus, unlike their forerunners in an earlier age, who were conscripted to supply the needs of kings and overlords, the new "serfs" will be dedicated to the service of the poor. Under the impulse of a spiritual revival—a living faith—these things, I admit, might be done in a spirit of willing sacrifice. As it is, I suggest that to succeed, the remedies propounded both by Sir William Beveridge and by Professor Fisher may, in a country sodden with liberal materialism, require the compulsion of an even more overriding dictatorship and control than any as yet exercised in the course of the present war. I am not prepared to deny that these things will not happen; nor, indeed, to assert that there is any convenient and ready alternative. But I do not see in this prospect any ground for complacency or for the hope that the journey to this "new order" can be other than stormy. Had the people not been lured on by false hopes and promises, things might be expected to turn out differently. Surely many would rather migrate to other parts of the Empire if this were permitted—and assisted—than face this hive-like future?

I am not quite sure I agree with Mr. Hawtrey when he says there was no trade cycle between the two wars, as I am never quite clear what a trade cycle is. But I should, myself, have said that we had a boom based on the development of domestic electricity and the motor-car, though this was cut in two by the slump of the early thirties, and complicated in the immediate post-war years by the fact that we were trying to revive the pre-war 1914 international system, whereas the developments just mentioned could flourish only under a protected national system. In the future I do not think we shall be troubled by trade fluctuations of the old type: our job will be to prevent persisting unemployment.

Mr. George Peel complains that I failed to mention the Atlantic Charter. I omitted it, first, because I have never yet met any practical man who knew what it meant, and second, because I did not wish to raise political issues before a learned society such as this. I take the view that the Atlantic Charter was the offspring of a marriage between political expediency and the obscurantist type of economic thinking of which I have complained in my opening remarks. Its purpose, I take it, was to placate isolationist sentiment in America, and provide an apparent alternative to Hitler's "New Order." I refer only, of course, to the British contribution to the document. A somewhat similar charter, Mr. Peel may remember, made its appearance at the end of the last war. I am not a politician, but I think charters of this kind are cruel to our fighting men. As on the last occasion these latter will, after being fawned on during the war, doubtless be condemned afterwards. The really interesting question is: Will they stand it a second time? I wonder.

Mr. Stanley Jevons has, I fear, misunderstood me. I never said anything for or against government ownership. The problem is not one that interests me. My concern is with the product: How is it to be distributed and who is to see that the consumer is to get a fair deal? There are plenty of proposals for safeguarding the earnings of management and men, but very few which are concerned with seeing that the ordinary consumer gets both a cheap and a serviceable product. As I write there lies on my table a pamphlet on Coal by

James Griffiths, issued under the auspices of the Labour Party, which provides a good illustration of the point.

Mr. J. E. Allen and Mr. E. R. Bransby both touch on the fringe of a vast problem. I share their aspirations, but I do not believe we can make a beginning until we have both cleared our minds of much cant and wishful thinking and tried to study the facts as they are, not as one would wish them to be. Remember there are over 2,000 million people on this planet, and heaven knows how many different forms of social and economic organisation.

Who is going to start this new crusade? Where are the leaders to come from? Not from this country, unless there is a complete change of spirit. I know that we still have many only waiting for the opportunity once again to strut across the world stage in the rôle of a new Messiah. But while we may forget their past records, the world will not. The British Empire, as J. A. Williamson has recently reminded us, "was not founded in a fit of absent-mindedness by third-rate persons who could prosper at no other undertaking. Its planning occupied the best brains of thinkers and masters of action." \*

Some may complain that I am being simply destructive. This is, in a way, true. But the word "reconstruction" is largely to blame for this. If, as I believe, we are living in a period of revolution, then it is entirely wrong to envisage reconstruction simply as a series of plans to be put into operation the moment an armistice is signed. Reconstruction there will have to be in the form of the rebuilding of destroyed property, the restocking of depleted shelves, and in general the changing back from a war to a peace time footing. This work is likely to keep most of us busy for some years after victory. But it is a relatively small matter. There is need for something vaster and more far-reaching—a re-direction of the forces and spirits of progress. But such a reorientation of ideas and objectives will involve destruction as well as construction; it cannot be effected in the twinkling of an eye. Besides, it is not something that can be done properly—or with fairness—without the active contribution of those at present engaged in fighting for our safety. Let us not forget that the new comradeship of effort brought into being by the war may turn out to be the only solid foundation that we shall possess on which to build that new world for which so many are yearning.

\* *The Ocean in English History.*

## MISCELLANEA

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## SOME SUGGESTIONS IN REGARD TO OUR AGRICULTURAL STATISTICS

By R. J. THOMPSON, C.B.

COMPARED with many other industries, the statistical information available in regard to agriculture in this country is detailed and comprehensive, but there are not unnaturally some directions in which further particulars seem to be needed. In the past, these deficiencies may not have been of much importance, but with the changed conditions arising out of the war there is likely to be in future a much greater need for fuller and more complete statistics, especially in regard to the economic side of the industry. It is not very easy to determine what is required, bearing in mind the difficulty in obtaining exact details, but as some contribution to the subject I venture to offer a few suggestions and to recall some points in regard to which gaps in the existing statistics have already been recognized.

One well-known gap in our information is the lack of exact knowledge as to the number and size of agricultural holdings. Practically all the many-sided legislation relating to agriculture, as well as the financial assistance which is given to the industry, is intended to aid persons cultivating the land as a means of livelihood, whether as farmers or as fruit growers, poultry farmers, horticulturists, etc., yet we have no means of knowing, except in a very rough and ready way, how many persons there are in these categories or what area of land they cultivate or what crops they are growing. It is true that our agricultural statistics give, with considerable accuracy, total areas under different crops and grass, but these total areas cannot be satisfactorily broken up so as to distinguish the number and size of "economic" holdings or still less the average make-up of holdings of any particular size. If the statistics are examined at all closely, we find that they include an undefined area of land which cannot be said to be farmed as a business proposition and also an undefined number of so-called "holdings" which are not self-contained undertakings. For example, there is a good deal of pasture in separate and detached fields or in parks attached to residential properties: in 1925, these were thought to cover in all over half-a-million acres. In addition, there are home farms and similar properties not run for profit, and land occupied by persons as a secondary or minor enterprise, such as grazing lands held by butchers, publicans and other rural tradesmen. All these separate pieces and parcels of land are technically "agricultural holdings" and are quite rightly included in the Agricultural Returns in order to ascertain the total area under the various crops (including grass) and the total number of live stock, but the result is that we have no certain knowledge of the area of land occupied by "farmers" in the proper sense of the word, or how it is farmed or of the number or average

size of their holdings. We have, it is true, the number of "holdings" divided up according to size in ten categories, and we may assume that the holdings above, say, 50 acres are for the most part occupied by persons engaged in farming for a living, but the figures would not be exact, and in any case the acreage corresponding to the size groups is not available, the latest information on this point referring, I believe, to 1924. In the same way the number of holdings under 50 acres includes all the small holdings proper, that is, holdings run as a means of livelihood together with an unknown but decidedly large number of detached fields, grazing lands and miscellaneous properties. This latter point vitiates all statistical consideration of the small-holding movement in regard to which there has been so much discussion and legislation, while the fact that we have no precise information as to the magnitude or scope of the farming industry proper seems unsatisfactory from every point of view.

The position may be illustrated by results obtained in an investigation by the Research Institute attached to the University of Reading into the distribution of agricultural land in the County of Buckingham in 1938. It was found that only 56 per cent. of the holdings returned by the Ministry of Agriculture were in fact full-time farms occupied by professional farmers, though in addition 15½ per cent. were spare-time or part-time holdings run for profit by persons with some other employment. The latter probably included a substantial proportion of "small-holdings." The remainder of the holdings consisted of home or hobby farms not run purely for profit, and plots of land let for grazing and other miscellaneous purposes. It is not known how far these percentages are representative of the country as a whole, but they are sufficient to show that a substantial proportion of the "holdings" returned by the Ministry of Agriculture are not "holdings" in the ordinary sense of being separate business undertakings and that no deductions can be drawn from them as to the average sizes of farms or the distribution of crops.

This anomaly has been recognized for many years: its remedy in pre-war days was no doubt hindered by administrative difficulties in the way of drawing a precise line of demarcation between different classes of holdings and by the cost of detailed investigation. The very much larger share in administration now taken by the County Authorities should facilitate local enquiry, and it is to be hoped that in the future it will be found possible to prepare annually statistics which will provide a true picture of the distribution of land between different classes of occupiers and of the changes which take place from year to year.

An allied question in regard to which information is desirable is the extent to which land is farmed by owner-occupiers and by tenants. Although it is thought that about one-third of the "holdings" in England and Wales are occupied by the owners, we do not know how far these are holdings farmed as a means of livelihood, the area they cover, their average size, or any other particulars.

Labour is another question in regard to which pre-war statistical information was far from exhaustive. A knowledge of the number of persons employed seems an obvious need, and so far as totals are concerned we have particulars in an annual statement by the Ministry of Agriculture based on the Agricultural Returns and showing the total number of regular and casual male and female workers in employment in June of each year. In 1939, the numbers so returned were 533,000 male workers and 73,000 women and girls. The number of male

workers includes, however, not only ordinary agricultural labourers, but also more skilled hands earning higher wages, such as cowmen, ploughmen, etc., as well as tractor drivers, foremen and bailiffs, together with farmers' sons and other relatives, who may be of any type. Men employed in professional horticulture and market gardening are also included. Our only guide to the numbers in the different categories is the 1931 Census,\* and apart from difficulties in comparison and uncertainties in classification conditions have changed so much since then that in 1939 there was little to indicate the composition of the aggregate total given by the Ministry of Agriculture. It may be thought that this is not of much importance, but it has to be remembered that the Agricultural Wages Board and the County Wages Committees prescribe separate minimum rates of wages for ordinary agricultural workers, for cowmen, stockmen and other skilled classes, for women, and for boys at various ages, and it certainly seems desirable that the number of persons affected by these different rates should be known. In its absence information as to average wages must obviously remain very defective.

A more general question in regard to which information is lacking is the relationship between agricultural prices and costs of production. When agriculture begins to approach more stable conditions after the war, this question is likely to become of importance and the old problem of securing "a reasonable remuneration for the producer" without excessive prices or excessive subsidies will once more have to be faced. Whilst everyone agrees that farmers should receive "a reasonable remuneration" for their labours, there is no obvious method of relating prices and costs of production which will give such a result, nor indeed is there any standard by which to measure what remuneration is "reasonable."

One school of thought claims that by certain intricate methods of book-keeping it is possible to isolate, as it were, all the charges borne by the farmer in producing any one particular crop or product, and thus to ascertain its true cost of production. Practically all farms in England, however, produce a number of crops, many of them so closely related that it is not possible to produce one without the other, and the attempt to make appropriate book-keeping allowances for the costs which are partly borne by several crops involves what are at best no more than expert guesses. For any individual farm these estimates may have a certain value as a guide to cultivation or management, but farms differ widely in soil, climate and type so that the results must of necessity differ too much to afford any indication of a cost of production capable of general application: an average would provide some producers with too little, some with too much profit; a figure intended to give some profit to those producers whose costs are highest would result in exorbitant profits for others. The idea of settling prices on any such method is, moreover, quite contrary to the usual farming practice, which is to treat a farm as a unit and to endeavour by a suitable combination of crops and live stock to earn a profit on the operation as a whole, taking one year with another. It seems to be on this latter basis that the problem of price-fixing can be most hopefully tackled, that is, by preserving such a balance of prices as will induce production of a certain supply and taking one price with another will provide a reasonable return to the average efficient producer. To do this by any "scientific"

\* The available information was analysed in "The Agricultural Labour Bill in England and Wales," R. J. Thompson, *R.S.S. Journal*, Part IV, 1937.

method is probably impossible, and in practice a solution is found empirically by discussion between representatives of the producers on the one hand and the controlling authorities on the other.

As an aid to these discussions and for the guidance and information of the general public who as consumers and tax-payers are vitally interested, additional statistical information of the right type is needed, but the problem is to discover precisely what is required and how it can be obtained. The Marketing Boards in the performance of their administrative duties must have obtained a vast amount of detailed knowledge relating to the commodities they control, and it is not in relation to them that further statistics appear to be needed, but rather in regard to the question of the position of farming in general, and the relationship between average prices and average costs not of single crops but of the mixed products of agriculture. This does not lend itself easily to measurement, but one contribution which may be suggested would be an index of costs of production admitting of comparison with the existing index of agricultural prices. In practice, it might not be possible to construct such an index for past years, but a basis for the future might be built up by the annual publication of tables relating to the principal items entering into costs of production; pending the construction of a definite index these tables would provide means for current comparison.

So far as these costs are concerned with commodities purchased by farmers, such as feeding-stuffs, fertilisers, seeds, machinery, petrol and other minor articles, price records should present little difficulty, and only need some kind of weighting in proportion to their relative importance to enable average changes to be compared from year to year. The prices of feeding-stuffs and fertilisers have in fact been published by the Ministry of Agriculture for many years. Other costs of production which need to be taken into account are rent and labour, and these are on a somewhat different footing. Labour has already been mentioned, and if more information as to the number of workers employed at varying rates of wages were available, an average wage could be calculated which would show fluctuations from year to year. As regards rent, direct information in the past has been very limited, consisting only of the rent records of certain estates. The area of these, however, compared with the total area of agricultural land was far too small to provide anything more than a very approximate indication of a possible average. Apart from actual returns, the only available information has consisted of detailed estimates made in 1925 and again in 1930 by the Crop Reporters of the Ministry of Agriculture. These showed rents ranging from £3 an acre on quite small holdings to 15s. per acre on farms of 500 acres and over, with an average of about 28s. in 1930, and probably indicated very well the sort of rents which were being obtained for newly let farms at that time. Estimates of this sort, however, have not quite the air of certainty required for a cost of production index, and they could hardly be expected to show variations from year to year. A better method which may be suggested, would be to ask occupiers to state on the Annual Agricultural Schedule their actual rents. In past years it has been supposed that occupiers would resent being asked this question, but it seems probable that a substantial proportion of occupiers of land would be quite willing voluntarily to state the rent paid for their farms and would thus provide a sample of sufficient size to justify the calculation of an annual average. This information as regards labour and rent, if combined with the prices of the principal com-

modities would, it is suggested, throw valuable light on average costs of production—a subject hardly touched by pre-war statistics.

It may be noted here that the proper weighting of the prices of feeding-stuffs, fertilisers, etc., involves a knowledge of the quantities used. The war has brought home to us very clearly the fact that agriculture in this country was and is dependent on imported supplies of materials, but in the past the extent of this dependence was always rather uncertain as no official estimates of quantities were issued, while the crude figures of imports were apt to be misleading, inasmuch as some imports were in part used for purposes other than agriculture or were raw materials for manufacture. Almost the only recent indication was an estimate by the Ministry of Agriculture in 1929 which put the annual average value of imported supplies used for production in Great Britain in the four preceding years at £78 millions, or about one-quarter of the value of the total output.\*

Apart from its importance from a practical point of view, a knowledge of the magnitude of imported supplies has a bearing on a problem of general interest, viz. the question of the net or real productivity of the soil.

The Ministry of Agriculture publishes annually an estimate of the value of the gross output of agriculture and horticulture, but in the absence of any corresponding estimate of the quantities and value of the purchased materials the net output cannot be calculated, and there has been no statistical means of judging how far the true productivity of the soil was being maintained or increased or, on the other hand, was actually shrinking. The problem is no doubt a highly intricate one, and it is not suggested that the mere publication of figures of imported supplies would at once furnish a simple reply, but they would be a step in the right direction and one without which any attempted solution is impracticable. In their absence a decline in the real productivity of the soil might be concealed by an apparent increase due to changes in methods of farming.

If the above information were available it would go far towards enabling an annual estimate to be made of the gross cost of production comparable with the annual estimate of the value of the total output. In a recent paper,† Mr. Kendall made a provisional estimate of this character for the years 1937–39 which pointed to some interesting conclusions. For instance, making use as he says of very inadequate data, he found that there was an apparent difference between farmers' receipts as shown by the value of the total output and the corresponding total expenditure involved in its production of some £82 millions, a sum which, if correct, would represent the farmers' remuneration for work and interest on invested capital. Owing to the lack of precision in some of these figures, this estimate may or may not be accurate, but provided more exact statistics were obtained an estimate of this type continued on a uniform basis over a series of years would have a real value. The changes from year to year would provide an indication how far the movements in agricultural prices were keeping pace, as it were, in movements in costs of production. It might even in course of time serve to suggest the sort of standard or average

\* Estimates of the consumption of animal feeding-stuffs other than those wholly home-produced were given in the Report of the Food (Defence) Plans Department for 1937.

† "The Financing of British Agriculture," M.G. Kendall, *R.S.S. Journal*, Part II, 1941.

relationship which could broadly be regarded as likely to provide producers with a "reasonable remuneration."

In this connection, a source of statistical information which has hitherto been neglected is possibly to be found in the income-tax returns. In the past, a farmer has normally been assessed for income tax under Schedule B, on the "annual value" of his farm, with the proviso that if he could show that his profits were less than the annual value, he could claim a reduction of the assessment to the actual profits. No information, however, appears to be available as to the extent to which advantage was taken of this alternative, although during the years of depression, particularly 1931-34, it might have afforded evidence of the extent to which farmers' profits were falling. If, as has sometimes been stated, very few farmers actually took the trouble to make returns showing their actual profits, this would seem to suggest that the level of earnings must have been at least equal to the annual value. Recently, as a result of the 1941 Budget, the system has been altered so far as concerns farms with an annual value of over £300 per annum, occupiers of which will be liable to income tax on actual profits under Schedule D. Farms of this class probably number some 20,000, and if the returns obtained were classified according to the size of the undertakings so as to show net average earnings we should, for the first time, have some reliable information on this much-debated question.\*

To this suggested use of the income-tax returns, the objection may possibly be raised that they are "confidential" and ought not to be used for any subsidiary purpose. But in view of the complexity of the agricultural problem, involving as it does large Government subsidies, control of production, and price-fixing, no channel of information can fairly be neglected, and farmers as a class may well find it to their advantage to be able to point to an unimpeachable indication of their financial position rather than to depend on unsupported testimony which may not be regarded as entirely unprejudiced.

An alternative source of information which may be mentioned is the Farm Management Survey, which has been carried on since 1934 by the Agricultural Research Institutes. The publication of results has been held up owing to the war, but in the future the Survey should provide information as to the financial side of farming operations.

Calculations of the kinds suggested above would do something to remedy a deficiency in our agricultural statistics which has been obvious for many years. In the not distant past when "agricultural depression" seemed to be a permanent subject of agricultural politics the difficulties of the problem were accentuated by the fact that no figures existed by which the extent of the depression could be either measured or tested—apart, that is, from the evidence of the fall in prices which, important as it was, took no account of possible economies in cost of production. With increasing State control and the growing extent to which consumers are likely to be affected, there seems to be an increasing need for statistics which will throw light on the economic side of farming.

\* By the 1942 Budget, the liability to income tax on actual profits under Schedule D is extended to all occupiers of farms assessed at £100 per annum and over.

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# APPROXIMATE PROBABILITY DISTRIBUTION FUNCTIONS FOR THE SUM OF TWO INDEPENDENT VARIATES

By J. E. MOYAL

## 1. Expansion in terms of the successive derivatives of the distribution function of one of the components

Let  $X_1, X_2$ , be two independent variates,  $X = X_1 + X_2$  their sum. Let  $y(x), \rho(x), \phi(x)$  be the distribution functions,  $m_n, \nu_n, \mu_n$  the  $n$ -th moments,  $M(t), M_1(t), M_2(t)$  the characteristic functions of  $X, X_1$  and  $X_2$  respectively. Since  $X_1$  and  $X_2$  are independent, the characteristic functions must satisfy the relation

$$M(t) = M_1(t) \cdot M_2(t) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$M(t) = M_1(t) \left\{ 1 + \frac{\mu_1}{1} (it) + \frac{\mu_2}{2!} (it)^2 + \dots \right\} \quad . \quad . \quad . \quad (2)$$

Taking the Fourier transforms of both sides of (2), and remembering the well known relation

$$\int_{-\infty}^{+\infty} y^{(n)} e^{itx} dx = (-it)^n \int_{-\infty}^{+\infty} y e^{itx} dx = (-it)^n \cdot M(t) \quad . \quad . \quad (3)$$

(where  $y^{(n)}(x) = d^n y/dx^n$ ) we thus obtain a formal expansion of  $y(x)$  in terms of the successive derivatives of  $\rho(x)$ :

$$y(x) = \rho(x) + \frac{\mu_1}{1} \rho^{(1)}(x) + \frac{\mu_2}{2!} \rho^{(2)}(x) + \dots \quad . \quad . \quad . \quad (4)$$

## 2. Expansion in terms of successive differences

Writing the finite difference of  $\rho(x)$ :  $\nabla \rho(x) = \rho(x) - \rho(x-1)$ , we obtain an expansion in terms of the successive differences of  $\rho(x)$  instead of its derivatives, by using instead of the characteristic function, the so-called factorial moment generating function  $H(\tau)$ , which is obtained from the former by the change of variable

$$\tau = 1 - e^{it} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

$$H(\tau) = M(t) = E(e^{itx}) = E(1 - \tau)^x \quad . \quad . \quad . \quad . \quad (6)$$

The  $n$ -th derivative of  $H(\tau)$  at the origin is then seen to be equal to the  $n$ -th factorial moment (denoted by  $\mu_{(n)}$ )

$$H^{(n)}(\tau) = (-1)^n \int_{-\infty}^{+\infty} x(x-1) \dots (x-n+1) y(x) dx = \mu_{(n)} \quad . \quad (7)$$

We therefore have as in (1) and (2)

$$\begin{aligned} H(\tau) &= H_1(\tau) \cdot H_2(\tau) \\ &= H_1(\tau) \left\{ 1 - \frac{\mu_{(1)}}{1} \tau + \frac{\mu_{(2)}}{2!} \tau^2 - \dots \right\} \quad . \quad . \quad . \quad (8) \end{aligned}$$

and as in (3)

$$\int_{-\infty}^{+\infty} (1 - \tau)^x \nabla^n y(x) dx = \tau^n H(\tau) \quad . \quad . \quad . \quad . \quad (9)$$

We then obtain by inversion the desired expansion

$$y(x) = \rho(x) - \frac{\mu_{(1)}}{1} \nabla \rho(x) + \frac{\mu_{(2)}}{2!} \nabla^2 \rho(x) - \dots \quad . \quad . \quad (10)$$



## REVIEWS OF STATISTICAL AND ECONOMIC BOOKS

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1.—*A Significance Test for Time Series*. By W. Allen Wallis and Geoffrey H. Moore. Technical Paper Number 1 of the National Bureau of Economic Research, Inc., New York. 1941.  $11\frac{1}{2}'' \times 7\frac{1}{2}''$ . xii + 59 pp. 50 c.

This brochure inaugurates a new series of publications from the National Bureau of Economic Research in New York, a series which "will deal with procedures or research findings that are technical in character and that have a somewhat more specialized appeal than the Bureau's *Occasional Papers*." Economic statisticians on this side of the Atlantic will welcome this project and watch its progress with interest. The initial volume, excellently printed and moderately priced as American statistical publications go, encourages the hope that the Bureau has begun a series of considerable use and importance.

The problem considered by Professor Wallis and Dr. Moore arises at the earliest stage in the examination of fluctuations in a given series: can those fluctuations be ascribed to chance? Nearly all time series, whether possessing a trend or not, exhibit oscillatory movements which may or may not be systematic in the sense that the value at any point is or is not dependent on values at adjacent points. The problem is to test whether the observed fluctuations can be regarded as the values of a purely random variable. It is an important problem, for until the point is decided, the investigator does not know whether there is any systematic tendency in his oscillatory series requiring further study. This, indeed, is so obvious that it would not be worth saying but for a deplorable tendency among opinionated trade cyclists to rush in with economic explanations of movements in time series without first establishing that there exists something to explain in economic terms.

There is clearly no limit to the number of tests which can be devised to determine whether a given series is not random. The present authors follow a method which has a great deal to recommend it. A value in the series which is greater than or less than its two neighbouring values is called a "turning point," in the former case being a "peak" in the latter a "trough." The interval between two turning points is a "phase." The question whether a given series of  $N$  terms is random is decided by comparing the number and duration of its phases with the expectations in a random series. The mathematics of the problem have already been considered in the case when  $N$  is infinite by other writers, notably Kermack and McKendrick.

It is characteristic of problems of this type, which are virtually those of determining ranking distributions, that although the actual distributions themselves are very difficult to obtain, their moments are often simple in form and can either be obtained directly or surmised with a high degree of probability from the values found for simple cases. The authors show that the expected number of

turning points in a random series of  $N$  terms is  $\frac{2(N-2)}{3}$ . They then give the values of the second, third and fourth moments of the distribution of turning points in such a series—i.e., in the population of  $N!$  possible permutations of rankings of 1 to  $N$ . These expressions appear to have been derived from numerical values worked out for lower values of  $N$ . To establish their accuracy with

complete rigour, it would be necessary to show that the  $r$ th moment contains a term of the  $r$ th power in  $N$ , but there can hardly be any doubt that the values given are correct. It appears that the distribution tends to normality fairly quickly, and thus a first test is arrived at: the number of turning points in a random series of  $N$  terms is distributed approximately normally about mean  $\frac{2(N-2)}{3}$  with variance  $\frac{16N-29}{90}$ . The exact probabilities are given up to  $N = 12$ .

The authors, however, regard this as an auxiliary test, their main concern being with the distribution of phase durations. It is shown that the expected number of phases of duration  $d$  is

$$\frac{2(d^2 + 3d + 1)(N - d - 2)}{(d + 3)!}$$

The values given by an observed series may be compared with those expected on this formula and  $\chi^2$  computed in the usual way. But here arises the difficulty.  $\chi^2$  so obtained is not distributed in the usual Type III form, for the occurrence of one phase duration in a series of  $N$  terms is not independent of the occurrence of others. The authors consider the particular value, denoted by  $\chi_p^2$ , obtained from the three frequency classes of duration 1, 2 and 3 and over. They have worked out the distribution exactly for values of  $N$  up to and including 12, and have obtained a number of experimental distributions by card shuffling for  $N = 25, 50$  and 75. Their conclusion is that if  $\chi_p^2$  is less than 6.3, then  $\frac{2}{3}\chi_p^2$  can be tested in the Type III distribution for two degrees of freedom; and that for higher values  $\chi_p^2$  can be tested in that distribution with  $2\frac{1}{2}$  degrees of freedom. This work might, perhaps, have been carried a little farther. From the exact distributions up to  $N = 12$  it may well be possible to derive expressions for the lower moments of  $\chi_p^2$  as polynomials in  $N$ , and to determine how far the moments deviate from those of the Type III distribution and whether a Type I distribution would give a better fit and permit of testing  $\chi_p^2$  in the  $z$  distribution.

The authors then proceed to illustrate their theory at some length on a series of U.S.A. sweet-potato acreages, and conclude with a historical note and references.

The proposed test has a number of attractive advantages: it is readily understood by the layman; the arithmetic required to apply it is comparatively slight; and it is independent of the distribution law of the fluctuations. On the other hand, the generality conferred by this last property is acquired only by the sacrifice of sensitivity, and possibly more searching tests may be required in particular cases. The research worker in time series will find much that is interesting, and possibly more that is stimulating in this work. There is scope for further research on the mathematical side, and, to judge from the incidental comments in the section on sweet-potato acreage, we may look forward to some useful further publications by the Bureau on crop cycles.

M. G. K.

2.—*Poverty and Progress: A Second Social Survey of York*. By R. Seebohm Rowntree. Longmans Green: London.  $9\frac{1}{2}'' \times 6\frac{3}{4}''$ . 540 pp. 15s.

This survey is an outstanding achievement, worthy in every respect to take its place alongside the classic work which the author produced forty years ago.

The first Part of the book is concerned with the economic aspects of the enquiry; the second is devoted to the social aspects of housing, public health and education, while the third deals primarily with the use made of leisure. The material on which the present book is based was collected in 1935 and 1936, when details were obtained of the composition, by age, sex and occupation, of nearly 16,400 families together with particulars of the dwelling occupied and the rent paid. The details of wages supplied by employers for 60 per cent. of the workers together with other sources of information and Mr. Rowntree's personal knowledge of the subject enabled him to obtain a very near estimate of family income. This estimate is compared with Mr. Rowntree's "human

needs" scale, which is taken as the criterion of poverty. For those families falling below this level, particular investigation was made as to the cause of poverty. Although the material relating to income was collected in 1935-6, it is felt that the general position thrown up by the investigation can very reasonably be taken as the position immediately before the war, since no appreciable change took place in unemployment, wage rates or cost of living during the intervening years.

The investigation attempted to cover all those households whose chief wage-earner was earning not more than £250 a year, and it is claimed that the number of such households omitted from the enquiry was negligible. In all, 16,362 families consisting of 55,206 persons (57 per cent. of the entire population of the city) and occupying 15,372 separate dwellings were covered. The families investigated were classified in five groups, two below and three above the standard. Of the population covered by the enquiry nearly one third, representing about 17½ per cent. of the total population of the city, fell below the "human needs" standard.

Mr. Rowntree recognizes that poverty can often be ascribed to more than a single cause, but he has taken the principal cause in each case falling below the standard and has classified the sub-standard population accordingly. There were over 17,000 persons living below Mr. Rowntree's minimum; the poverty of nearly 30 per cent. was mainly due to unemployment, while that of well over 40 per cent. was attributed to inadequate wages and earnings (primarily in transport, factories and workshops). Old age accounted for a further 15 per cent. Detailed attention is given to each of the various circumstances held primarily responsible for the grading of those below the "human needs" standard. Thus, for example, the unemployed are sub-divided into those fit, capable and looking for work, those who are fit but not eagerly looking for work, and those unlikely to work again through physical incapacity. The other causes of poverty are similarly investigated with searching criticism. The author then probes farther, and examines what he defines as "primary poverty," that is, the conditions and circumstances of those falling below the standard commonly known as the "poverty line," a standard considerably lower than that of "human needs." In 1899, as many as 15½ per cent. of the working-class population were below this lower standard; in 1936 the proportion was 7 per cent. Social effort over nearly 40 years has removed little more than half of the abject poverty in York. The causes of real poverty at the two dates makes interesting reading. In the earlier enquiry half of it was due to the low wages of those in regular work; this cause in 1936 was responsible for less than 10 per cent. of those living below the poverty line. Unemployment, on the other hand, was responsible for less than 2½ per cent. in 1899 and over 44 per cent. in 1936. These two causes together, unemployment and low wages, in each enquiry accounted for 54 per cent. of primary poverty, but their relative influence in 1936 was the complete reverse of that in 1899. In considering those whose family income places them above the minimum, attention is particularly given to those who by reason of expenditure on non-essentials are actually living below the minimum. Mr. Rowntree admits that he has no foundation of ascertained facts on which to base a measured estimate, but he would find it difficult to prove wrong an assessment of between 7 and 10 per cent. of the working-class population. His final conclusion is that about 40 per cent. of the working-class population of York are living below the minimum; three-quarters of the cases are due to lack of means and one quarter to the ill expenditure of otherwise adequate means.

A close study was made of 28 family budgets which had been maintained in very considerable detail over 4 weeks. While it is recognized that this is far too small a sample from which to generalize, it is, nevertheless, most striking to see the extent to which those of these families living below the minimum are literally underfed. The diet of the lowest group of all is deficient in every nutritive item, with the single exception of vitamin C, largely derived from potatoes.

The last chapter in Part I largely deals with thrift, in which connection the importance of the Co-operative Society and the part played by Friendly Societies and Trade Unions are clearly demonstrated. Woolworth's, Marks and Spencer's and the British Home Stores are given their share of mention.

Part II of the book deals with housing, health and education. The chapter given to housing brings out the considerable progress made over the 40 years during the two surveys. The efforts made by the Municipal Authorities over the last 15 years or so in slum clearance are sympathetically discussed, and although the criticism suggests that the Authorities might have exercised rather more foresight in certain respects, much credit is given to them for the considerable improvements they have in fact achieved. The cost and the rent of houses are briefly dealt with, as also is the relationship between the number of rooms and the rent. These sections of the chapter consist almost entirely of textual matter; one or two tables would have made their substance easier to assimilate. The following comparisons between the conditions in 1900 and 1936 illustrate the progress made. In the earlier year, baths were practically unknown in working-class houses; in 1936, a quarter of these houses had baths. Over a quarter of the working-class families in 1900 lived in slums; in 1936 less than 12 per cent. lived in slums. The 1400 "back-to-back and not-through" houses existing in 1900 have almost disappeared. Even so, the author is careful to point out what still remains to be done before the Council can feel really satisfied that all the citizens of York are living in wholesome houses. The chapter entitled "Health" is very largely an exposition of the vital statistics of York, in relation, as far as possible, to classes of income. One of the many tables of interest shows how the stature and weight of children have increased class by class over the 40 years. In this respect weight appears to have made a larger gain than height. The third and last chapter in Part II discusses the educational opportunities that exist in York for children of working-class parents and the extent to which they are utilized. The various stages in the educational career are examined one by one—the Nursery, Infant, Junior, Senior and Secondary or Higher Grade schools. A critical consideration is given to each class of school, with an approach obviously sympathetic to the child. Thus, it is stated that "as long as Senior Schools are regarded as dumps for inferior children, so long will those children suffer a grave injustice." It is not easy for a child to ascend the educational ladder; few have the type of mind required to pass the examinations that have to be overcome in order to reach the top of the ladder, and the chances of getting to a University are very few.

The third part of this book examines what the working classes in York do with their leisure time. This subject is covered under three headings: (a) active pursuits—*i.e.*, in which those concerned take some active part, *e.g.*, public-houses, Girl Guides, tennis, cycling, betting and gambling; (b) passive pursuits—*i.e.*, in which those concerned do not themselves participate, *e.g.*, the cinema, the theatre, or watching football or horse-racing; and (c) religious activities, consisting of church attendance or week-day church interests.

The various clubs in the city are excellently described, and it is apparent that the club amenities available for the adolescent are far too few, "for it is just when young people leave school and go to work that they stand most in need of the kind of help a good social club can give." Considerable attention is given to the part played in the social life of York by the public-house, to which, it is estimated, about 180,000 visits are made each week. The sex and age of customers are classified according to four types of house; the daily variation in attendance during the week and the extent to which customers enter singly or in groups are also estimated. This detail illustrates the care with which each type of active and passive pursuit is measured and described. Thus we find that tennis over recent years is tending to diminish in popularity, whereas bowls has increasingly attracted the younger men. The extent to which betting and gambling, not only in respect of horse-racing and football, but in a dozen ingenious and surprising ways, has entered the general life of

the working man and woman, is astonishing even to one who was expecting a fairly deep infiltration.

Church attendance was measured by a census taken on two Sundays in the autumn of 1935. The number of adults attending church was 25 per cent. less than in 1901, although the population increased by 50 per cent. The Non-conformists lost more than the Anglicans or the Salvation Army, and the Roman Catholics were the only body to gain. The number of persons participating in the week-night activities of the churches was also counted, and it appears that 96 per cent. of the 7,300 people concerned attended either the Anglican or the Nonconformist meetings. This chapter on leisure-time activities concludes with the daily detail describing how a number of people spend their free time as recorded by the individuals themselves. One gathers that men in general have a more varied set of interests than the women, but that while the record for some women is admittedly a story of depressing monotony, others seem to enjoy a fairly interesting life. It almost seems that some women make themselves slaves to the drudgery of household affairs, while others manage to enjoy a commendable balance of interests.

The final chapter gives summary and conclusions, from which it is clearly demonstrated that while so much has been achieved during the last 35 or 40 years, much more has yet to be done. One of the difficulties, it may be inferred, is that the conception of what is right and proper for the community marches ahead almost as rapidly as the rate at which progress can be achieved, so that the objective is only reached by perpetual and perspicacious effort.

There is also a "Supplementary" chapter of little interest to the general reader, but more particularly designed for the statistician. Mr. Rowntree's investigations are based on a house-to-house enquiry covering the whole of the working-class population, whereas the majority of other social surveys are based on a sample enquiry, and this "Supplementary" chapter discusses the adequacy of the results given by the "sample" method. For this purpose, the 16,362 schedules used for the present investigation were arranged in street order and 1 in every 10, 20, 30, 40 and 50 selected. The 23 tables giving the comparison between the full enquiry and the sample results for a number of various classifications illustrate how the percentage inaccuracy increases as the absolute numbers become smaller. It is accordingly demonstrated that many of the very small numbers throw up an error of at least 20 per cent.

The appendices, running from A to Y, give all the statistical detail one could require over and above what is given in the text. The acknowledged experience of Mr. Rowntree is apparent throughout this enquiry, which will automatically take its place amongst the outstanding works of social investigation. It is most competently done, and the important results emerging from it cannot for a moment be neglected in any consideration of future social policy.

R. F. G.

3.—*Food Production in Western Europe*. By P. Lamartine Yates. London: Longmans. 1940. 9½" × 6½", xv + 572 pp. 15s.

That the early economists should have drawn upon the field of agriculture to such a large extent in the formulation of their theories was a natural outcome of the industrial development of their era. It is equally understandable that later students should have become interested in other fields of production, even to the virtual exclusion of agriculture. In recent years there has been a tendency for this lack of balance in the subject-matter of economic inquiry to be corrected by a renewed interest in agricultural problems. This development, which appears to be both desirable and inevitable, is undoubtedly due to the peculiar conditions obtaining in this branch of industry, and the urgency of its problems. *Food Production in Western Europe*, which is a proof of the preceding contention, has been materialized as a result of the interest of Lord Astor and Mr. B. Seeböhm Rowntree in this subject. It is a natural and worthy successor of *The Agricultural Dilemma* and *British Agriculture*, and they are to be congratulated upon their wisdom in entrusting this investigation to Mr. Yates.

In this country, knowledge of European agriculture, of a co-ordinated and comparative character, has been far too scanty, in spite of the lessons to be learnt by our agriculturalists from the experience of producers in other parts of Europe. Mr. Yates is to be commended both for the quality and the extent of his researches; as a contribution to the knowledge of agricultural organization the book is of first-class importance. His primary object was to answer the question: How far has the agricultural development in these countries (*i.e.*, Western Europe) been beneficial to public welfare as a whole? More specifically, he has attempted to find the solution to the problem, Has it or has it not been advantageous to them to retain in farming a much larger proportion of their population than Britain? In order to answer these questions, Mr. Yates has supplemented his wide knowledge of agricultural problems by a tour of Denmark, the Netherlands, Belgium, France, Switzerland and Germany. It may be said that he has succeeded in his design, particularly so far as the broad issues are concerned. He shows how the various policies of the Governments of the Western European countries, aimed at the protection and development of agriculture, have, for the most part, been of an immediate and narrow benefit only; the public at large have often suffered by the operation of these experiments. The suggestions of Mr. Yates for the enlightened planning of agriculture in the interests of the general community are well worth studying; the volume may be recommended to the agriculturalists and the legislators of this country, particularly when they are considering post-war reconstruction. Incidentally the present war, with its emphasis upon the "economic front," gives an added interest to the contents of this publication.

Lastly, mention must be made of the well-chosen photographic reproductions and diagrams which enliven the pages of this book. F. E. R.

4.—*Railways in Modern India*. By Professor R. D. Tiwari. Bombay: New Book Company. 1941. 8½" × 5¼". x + 284 pp. Rs. 10.

*Railway Rates Policy*. By Professor R. D. Tiwari. Bombay: New Book Company. 1940. 7¼" × 4¾". 82 pp. Rs. 2 8.

Professor Tiwari draws a rather gloomy picture of Indian railway development. In the initial stages, railroad construction was both costly and slow. The broad gauge was adopted, and proved to be an expensive luxury. The State later established metre-gauge railways in the interests of economy in capital expenditure, and the break of gauge was accepted as a necessary evil. Finally, Professor Tiwari claims that both the State railways and the private companies have lacked a proper appreciation of public requirements. Traffic to and from the ports has always been favoured at the expense of purely internal traffic. Rates have been kept at too high a level, and the traditional policy of obtaining a maximum amount of revenue from a minimum amount of traffic has retarded industrial development.

For much of this the State itself has been to blame. The unconditional guarantee of 5 per cent. interest on capital given to early companies undoubtedly robbed them of a powerful incentive to provide an economic and efficient service, and, moreover, it placed a heavy burden on the Indian taxpayer. It is doubtful, however, whether the State could be seriously blamed for giving weight to political considerations in the sanctioning of schemes of railroad construction. With attention focused upon American experience, Professor Tiwari has overlooked the fact that other countries have planned their communications with a similar bias without having any subsequent cause for regret. However, for the mistakes made in the early days there is some excuse, but for the ill-advised policy of later times there is none. The contribution to the general budget exacted from State railways constituted a very undesirable tax on industry. The inability of the Government to appreciate railways as a long-term commercial undertaking is revealed by its policy of financial starvation, which resulted in inordinately slow growth in the mileage of lines open for traffic. In the sphere of administration, the State was very reluctant to remove railway control from the Department of Commerce to a separate Department of Communications,



and in spite of the strong recommendations of the Acworth Committee and of other independent experts, it has not considered it necessary or desirable to set up an impartial Rates Tribunal on the English or American model.

These criticisms are levelled by Professor Tiwari in *Railways in Modern India*, and are followed by practical suggestions which form the basis of a progressive railway policy. The argument in the text is supported by appropriate statistical data, although an error appears to have crept into the table on page 157. The concluding chapter in the book deals with the familiar problems arising out of unrestricted rail and road transport competition, and a measure of co-ordination between the activities of all transport agencies is recommended.

*Railway Rates Policy* is a smaller work, covering briefly much the same ground, but having special reference to the principles governing the formulation of a railway rates policy. Here Professor Tiwari emphasizes the importance of the particular pattern of discrimination on which a rate structure is based, and shows the value of uniform classification of goods and of continuous "telescopic" rates for through traffic. Chiefly, however, he stresses the need of Indian industry for lower rates. The railways appear to have been very lax in the regulating of expenses, and the weakness of the position of the Railway Rates Advisory Committee in the machinery for dealing with traders' appeals against high rates has prevented the companies from being compelled to seek substantial economies. In consequence, the rates have remained at a high level to the detriment of internal industrial development.

T. M. R.

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## STATISTICAL NOTES

## 1. BRITISH OFFICIAL STATISTICS

APART from a considerable advance in the prices of barley and smaller advances in certain other cereals, *wholesale prices* generally showed little change during the first three months of 1942. The Board of Trade index-number of general wholesale prices (average of 1930 = 100) advanced from 155.9 in December 1941 to 158.8 in March 1942, but this advance of 1.9 per cent. was principally due to a steep rise in the index-number for the group of cereal prices, amounting to 20 per cent. Prices of English barley rose from 34s. 1d. per cwt. during the last fortnight of 1941 to 57s. 2d. in the last fortnight of March 1942, or over 67 per cent. Prices of English barley had been even higher during the first fortnight of March 1942. The price during the last week of March 1941 was only 18s. 10d. per cwt. No doubt the large increase is due to the present great demand for malting barley. Apart from the change in cereal prices, which also included small advances in the prices of wheat and oats, the only noticeable change was an advance in the index-number for the chemical and oils group of about 3.5 per cent. owing to increased petroleum prices. There was a slight fall in the group of miscellaneous industrial materials, due to a decrease in the prices of certain kinds of hides.

Compared with March 1941 there was a rise in the index-number during March 1942 of 5.3 per cent., prices of industrial materials advancing 3.2 per cent. and those of food and tobacco about 9.6 per cent. Here again the rise in the index-number for food and tobacco was due entirely to the increased prices of cereals, which rose about 43 per cent. over the twelve months.

Date	Total Food	Total not Food	All Articles	Basic Materials	Intermediate Products	Manufactured Articles	Building Materials
Dec. 1941 ... ..	150.5	158.4	155.9	170.5	167.7	150.3	141.8
Jan. 1942 ... ..	151.6	158.5	156.4	170.5	167.8	150.7	141.9
Feb. „ ... ..	156.9	159.0	158.5	170.6	167.8	151.1	142.6
March „ ... ..	157.9	158.9	158.8	168.3	167.9	151.7	142.9
March 1941 ... ..	144.1	153.9	150.8	163.6	163.6	147.3	137.7
Dec. 1940 ... ..	144.5	150.4	148.6	158.2	160.7	144.3	132.8
„ 1939 ... ..	118.1	124.3	122.3	135.0	125.0	122.0	110.3
Aug. „ ... ..	90.4	102.2	98.1	94.5	104.0	108.7	104.1
Percentage increase in March 1942 over—							
Dec. 1941 ... ..	4.9	0.3	1.9	1.3 *	0.1	0.9	0.8
March „ ... ..	9.6	3.2	5.3	2.9	2.6	3.0	3.8
Dec. 1940 ... ..	9.3	5.7	6.9	6.4	4.5	5.1	7.6
„ 1939 ... ..	33.7	27.8	29.8	24.7	34.1	24.3	29.6
Aug. „ ... ..	74.7	55.0	61.9	78.0	61.4	39.6	37.3

\* Decrease.

Since the commencement of the war general wholesale prices have risen nearly 62 per cent.; prices of food and tobacco advancing nearly 75 per cent., and those of industrial materials and manufactures over 55 per cent. Basic

materials (excluding fuel) rose rather more than 78 per cent. and building materials 37 per cent. As quite a large number of the articles of food and of metal and minerals are controlled as regards price or supply, or as regards both, the fluctuations or stationariness of the Board of Trade index are to an appreciable extent artificial. In addition, some of the articles of food are subsidized, and differing prices are charged for certain articles, according to the uses to which they are put.

The Board of Trade index-number of wholesale prices for the first quarter of 1942 is given on p. 51, together with the increases at March 1942 over price set the specified dates.

It will be noticed that prices in the main groups have not risen as much as 10 per cent. since December 1940. In the sub-groups of cereals and of textiles other than wool, the increases have been above that figure, but only in the case of cereals has the advance (37 per cent.) been noticeably greater.

The trend of wholesale prices as indicated by some other British index-numbers are shown below together with the official index number of the United States Bureau of Labor.

Date	Board of Trade (1930 = 100)	<i>Economist</i> (1927 = 100)	<i>Statist</i> (1866-77 = 100)	<i>The Times</i> (1913 = 100)	U.S. Bureau of Labor (1926 = 100) *
Dec. 1941 ... ..	155·9	108·5	146·5	171·7	93·1
Jan. 1942 ... ..	156·4	108·8	148·6	172·2	96·2
Feb. „ ... ..	158·5	109·9	153·4	178·5	96·4
March „ ... ..	158·8	110·3	153·5	179·1	97·2
<i>March 1941</i> ... ..	<i>150·8</i>	<i>104·3</i>	<i>138·0</i>	<i>166·4</i>	<i>81·1</i>
<i>Dec. 1939</i> ... ..	<i>122·3</i>	<i>91·7</i>	<i>120·1</i>	<i>142·5</i>	<i>84·3</i>
<i>Aug. „</i> ... ..	<i>98·1</i>	<i>70·3</i>	<i>90·4</i>	<i>114·5</i>	<i>80·5</i>

\* Mean of weekly figures.

General wholesale prices in the United States had by the end of March 1942 advanced only about 20 per cent., but the rise in primary products had been very considerable, amounting, according to the Bank of England index-number of primary products in the U.S.A., to nearly 55 per cent., compared with a rise in Great Britain of similar products of 37·6 per cent. The increase in U.S.A. was most marked in the case of wheat, maize, rubber and cotton.

Since the beginning of December 1941 there has been some slight decline in the *retail prices* of articles of working-class consumption so far as they are included in the index-number of the cost of living prepared by the Ministry of Labour and National Service, which has fallen from 201 at December 1st, 1941 (prices at July 1914 = 100) to 199 at April 1st, 1942. The decline has been entirely in food prices, which show a fall of 3·0 per cent. due to a reduction in the maximum prices of sugar at the end of December 1941 by 1d. per lb. and a reduction in egg prices of ½d. each at the end of March 1942. On the other hand, there has been an increase in the cost of clothing of about 2 per cent., with slighter increases in the prices of fuel and miscellaneous items of expenditure. Food prices at the beginning of April 1942 showed an advance of 16 per cent.

since the commencement of the war, prices of clothing about 95 per cent., of fuel and light 27 per cent. and of other items 31 per cent. Taking all items of expenditure, the increase since the start of the war is estimated at about 28 per cent. of which nearly 4 per cent. is held to be due to increases resulting from the Purchase Tax, and about 1.7 per cent. to increased taxes on sugar, matches and tobacco. (The result of the additional tax on tobacco imposed during April 1942 is excluded from these figures.) The index-numbers for the five months December 1941 to April 1942 are given below. It should be noted that they are intended to show the average increase in the cost of living since July 1914, "no allowance being made for any changes in the standard of living since that date, or for any economies or readjustments in consumption and expenditure since the outbreak of war."

(Prices at July 1914 = 100)

Date	Food	Rent and Rates	Clothing	Fuel and Light	Other Items	Total
Dec. 1st, 1941 ...	165	164	395-400	230	232	201
Jan. 1st, 1942 ...	163	164	400	230	233	200
Jan. 31st, " ...	163	164	400-405	230	234	200
Feb. 28th, " ...	162	164	405	230	234	200
April 1st, " ...	160	164	405	232	235	199
<i>April 1st, 1941 ...</i>	<i>170</i>	<i>164</i>	<i>355-360</i>	<i>225</i>	<i>226</i>	<i>198</i>
<i>Sept. 1st, 1939 ...</i>	<i>138</i>	<i>162</i>	<i>205-210</i>	<i>180-185</i>	<i>180</i>	<i>155</i>

During the four months from the middle of November 1941 to the middle of March 1942 *unemployment* continued to decline, apart from a slight increase in January, mainly due to severe weather conditions restricting outdoor employment on the day when the count of the unemployed took place. Temporary increases at that date in the number of boys and girls recorded as unemployed was principally due to the registration of school-leavers at the end of December 1941.

The numbers of registered unemployed as published by the Ministry of Labour for March 16th, 1942, exclude for the first time the numbers of men and women on the registers who have been classified by interviewing panels of the Ministry as unsuitable for normal full-time employment. The figures shown in the following table have therefore been amended for the earlier months. The figures given in earlier issues of the *Journal* include those thus classified but the classification did not start until February 1941.

Date	Wholly Unemployed	Temporarily Stopped	Persons normally in Casual Employment.	Total	Males	Females
Nov. 17th, 1941 ...	141,087	16,012	11,106	168,205	84,212	83,993
Dec. 8th, " ...	134,834	13,261	9,869	157,964	78,714	79,250
Jan. 12th, 1942 ...	141,226	14,736	9,250	165,212	89,292	75,920
Feb. 16th, " ...	133,602	17,267	8,975	159,844	92,747	67,097
March 16th, " ...	121,646	8,236	5,880	135,762	77,231	58,531
<i>March 17th, 1941 ...</i>	<i>325,889</i>	<i>75,691</i>	<i>17,919</i>	<i>419,499</i>	<i>194,928</i>	<i>224,571</i>
<i>August 14th, 1939 ...</i>	<i>968,108</i>	<i>211,978</i>	<i>51,606</i>	<i>1,231,692</i>	<i>947,099</i>	<i>284,593</i>

In March 1942 the number of males held to be unsuitable for "ordinary industrial employment" was 25,973, and the number of females "unsuitable for normal full-time employment" was 1,709. In addition, 1,607 women were classified as "unable for good cause to transfer to another area." These latter women are included in the number of unemployed.

Compared with twelve months earlier, the number unemployed at March 16th, 1942, showed a reduction of nearly 284,000, and compared with August 1939 a reduction of 1,096,000. The number at March 16th, 1942, was, of course, lower than at any period since the complete registration of the unemployed.

## 2. OTHER STATISTICS

The *Statistics of Failures in the United Kingdom and Ireland*, published annually by Mr. Richard Scyd, show that in the year 1941 there were 1,023 failures, of which 723 were bankruptcies.

In the wholesale trades there were 70 failures, of which all but 9 were in England and Wales and over half occurred in London and the Cotton district (29 and 11 respectively). The numbers compare with totals of 649 in 1913, 316 in 1939, and 170 in 1940, the figures for London in those years being 231, 137, 68, and for the Cotton district 92, 50, 23. The highest numbers in particular trades were, not surprisingly, among commission agents (8) and warehousemen and importers of foreign goods (6).

In retail trades there were 748 failures (against 3,869 in 1939 and 2,471 in 1940). The largest number, 86, occurred among grocers, provision merchants, etc. Next in order were builders, 70; farmers, 56; plumbers, painters, etc., 44; clerks and commercial travellers, 41; drapers and hosiers, 39.

The professional classes showed 114 failures, the highest number, 20, being for auctioneers and surveyors. Next came actors, artists, etc., and retired officers, with 16 in each category. Figures for this last class have remained steady in the years compared. There were 91 failures of private persons.

1,035 Limited companies were wound up voluntarily; 949 in England and Wales, 62 in Scotland, 6 in Northern Ireland, 18 in Eire.

The last edition of the *Anuario Estadístico* published by the Statistical Office of Spain was issued in 1935 and gave figures for the year 1933, with such as were available for 1934. The next issue, covering 1935, was in preparation when the civil war started, but was never published; and owing to the disorganisation of all State Services which ensued, it has not yet been found possible to undertake the compilation of a volume on the same scale. The office has therefore published a handbook, substituting for the former 992 pages, 10" by 7½", plus 88 whole-page maps and diagrams 521 thin paper pages 6" by 4". Such a portable summary for handy reference was contemplated as a Supplement to the large volume before the war in Spain; it now replaces it until the more comprehensive *Anuario* can again be published, and is greatly to be welcomed. It comprises the same main Sections, eleven in number, and gives the principal statistics in each, with illustrative graphs and international figures for comparison. Each section is preceded by a short explanatory survey of the statistical information, and another useful innovation is the reference to the sources of the data on each sectional title-page.

The information is brought up to the year 1939, sometimes to 1940, and comparisons of the latest figures are made with the 1935 and the preceding years, since statistics could not be compiled for the years 1936-38. The Director of Statistics states that he will be glad of any criticisms or suggestions for improvement. On a first inspection, he is to be congratulated on the amount of information contained within a small compass and the clearness with which it is presented.

### CURRENT NOTES

Statistics, Economics, and Actuarial Science have been recognized in the June Honours list by the elevation of John Maynard Keynes to a Barony of the United Kingdom, of George Selby Washington Epps to a Knighthood of the British Empire, and of Hector Leak to the rank of Commander of the British Empire. All three are present Members of the Council of the Society, and Mr. Leak was President in 1941. The Society warmly congratulates all three recipients of these well-deserved honours.

A message from Sir Alfred Flux, sent through the Red Cross on February 26th, lately reached friends, to whom he sent greetings and reported that he and Lady Flux were "quite well."

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## OBITUARY

J. CALVERT SPENSLEY, O.B.E.

By the death of Mr. Spensley on January 22nd, 1942, at the age of seventy, the Society has lost a wise counsellor who served it unostentatiously in many ways. He was elected to fellowship in 1897, and became a Life Member. From 1917 to 1940, when he left London for Devonshire on account of his health, he served on the Council continuously except for the temporary retirements necessitated by the seniority bye law. Spensley was a member of the Library, the Executive and the Housing Committees. On the Executive he was unofficial assistant treasurer, but it was as member of the Housing Committee that he put the Society under a great obligation.

When it was decided to demolish Adelphi Terrace, the Society had to find a new home, and Spensley took entire charge of moving the Society's Library to Portugal Street. This was not an easy task—many hundred feet of new shelving had to be erected, and thanks to Spensley's supervision the 70,000 books and pamphlets were safely transferred and installed.

Spensley was a statistician of the kind envisaged by the founders of the Society, skilled in the presentation of statistical data in tabular form and the elucidation of their meaning. Most of his statistical work is on the records of the London County Council, and the Society is indebted to a former colleague of Spensley's on the County Council for the attached note. He read before the Society on January 15th, 1918, a long paper on Urban Housing Problems. With the discussion, it occupied 68 pages of our *Journal*, not a record, as Drage's paper on pre-war Statistics of Poland, which followed Spensley's paper, occupied over 90 pages !

Spensley was a delightful colleague, a regular and welcome attendant at the dinners of the Statistical Dining Club. He did not look his age. After what must have been his sixty-eighth birthday he spoke with pleasure of a birthday gift of a stainless-steel spade that he intended to put to hard use. L. I.

I first met Spensley in 1894. I had just left school, and had passed the Entrance Examination for London County Council clerkships. I attended the County Hall in accordance with instructions, and was told that I had been allocated to the recently created Statistical Department under the leadership of Mr. G. L. Gomme (later Sir Laurence Gomme, Clerk of the Council). I was told by the departmental messenger that Mr. Gomme could not see me at the moment, but that Mr. Spensley, the second in command, would deputize for him. And so I met Spensley. Never was so youthful a second in command. I was 18, he was 23 or 24, but he looked younger. In fact he looked very little older for the next 30 or 40 years, though the red hair lost its vividness and he put on some weight.

Then followed eight or ten years of queer activity—queer, that is, in the retrospect, though we were all terribly earnest at the time. We were a very young department in more ways than one—Gomme himself was barely, or under, 40; the Progressives were in the saddle and looked like remaining there; and muni-

cialization was in the air. Accordingly we proceeded to prepare schemes (most of which issued in abortive bills in the House) for the Council to take over water, gas, electricity, the City of London Corporation, the Port of London, even pawnshops. Strangely, we never tried our hands on education, public assistance, and hospitals, all of which fell into our laps, unsought, years later—under a Conservative régime. Without exception none of our schemes went through, though it can hardly be doubted that the agitation roused at the time played its part in the later reforms.

It was on this and similar work that Spensley spent the first ten years of my official career (his had not begun much earlier). I remember him as a very acute and alert intelligence, a master of detail and a brake on some of Gomme's wilder flights. He lacked, perhaps, push and personality, and made a poor impression in Committee, but members learnt to rely on his knowledge and accuracy and soundness of judgment; and they may have valued his gifts at least equally with the brilliance of his chief.

When Gomme became Clerk of the Council we hoped rather than expected that Spensley would become chief, but, instead, E. J. Harper (afterwards Sir Edgar Harper) was appointed. Thereafter the tempo lessened somewhat—a fact due, not so much to the change of chief as to the change in the colour of the Council in 1907.

Some years later—in 1911, I think—Harper left the Council's service under rather astonishing circumstances, and the Department was destroyed. Spensley fought hard for its existence, but he failed. We were scattered through three of the older departments, and I never worked under him again, though I saw him and talked with him frequently. My work continued along the old lines more closely than his, for I was transferred to the department of the Clerk of the Council, and continued statistical work under Sir Laurence Gomme, whereas Spensley was transferred to the Estates and Valuation Department, and spent most of the rest of his official career on assessment work—and of this I cannot speak.

I think Spensley would have gone much further in the Council's service but for a diffident and somewhat awkward personality. He was a bad hand at putting his best wares to the front—an important element in achieving success. And he had good wares: sound critical judgment, a fine knowledge of London government, patience and industry. All this—but the gods will always withhold something.

P. E. B.

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## STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS

### UNITED KINGDOM—

#### *The Banker*—

March 1942—The finance of supply.

April 1942—Modern credit technique. Building societies in 1941 : *H. E. Wincott*.

May 1942—The future of the franc: *Robert Vacher*. The future of sterling: *Robert Vacher*. The national finances.

#### *The Bankers' Magazine*—

April 1942—National debt and its burden to the community.

#### *Economica*—

February 1942—Technical progress, costs and rent: *Gordon F. Bloom*. The monetary theory of D. H. Robertson: *J. R. Hicks*. Wartime control of prices: *Frederic Benham*.

#### *Economic Journal*—

April 1942—An industrialist's reflections of the future relations of Government and industry: *Samuel Courtauld*. The German war economy—V: *H. W. Singer*. Social reconstruction by the regulation of incomes: *Romney Green*.

#### *Eugenics Review*—

January 1942—War and the birth rate. Eugenics and poverty: *R. M. Titmuss* and *François Lafitte*.

*Institute of Bankers, Journal*, April 1942—Some twentieth-century economic trends: *W. F. Crick*. Banking in Soviet Russia: *P. Bureau*.

#### *Oxford Institute of Statistics, Bulletin*—

January 1942, No. 2—Excess profits tax and Government contracts: *M. Kalecki*. Output and employment policy: *F. Burchardt*.

February 1942, No. 3—Changes in the retail trade in groceries: *T. Schulz*. Employment, wage-bill and cash circulation: *M. Kalecki*.

March 1942, No. 4—War transport: *E. J. Buckatzsch*. Wages and income tax: *J. H. Nicholson*. Labour and industrial output: *T. Schulz*. Some features of British cotton exports: *S. Moos*.

April 4, 1942, No. 5—The impact of the war on India: *J. Steindl*. German price policy: *F. Burchardt*.

April 25, 1942, No. 6—The Budget: *M. Kalecki*. Consumption and rationing: *J. L. Nicholson* and *G. D. N. Worswick*. The rayon industry and the war: *D. B. Halpern*.

May, 1942, No. 7—Fuel rationing. A "human needs" diet in war time: *T. Schulz*. Wages and the national income in 1940 and 1941: *M. Kalecki*.

Supplement, April 1942—War and the small retail shop.

*Oxford Economic Papers*, April 1942—Trade balances and exchange stability: *A. J. Brown*. The controls in post-war reconstruction: *C. J. Hitch*. British raw material controls: *G. D. N. Worswick*.

*Public Administration*, October–December 1941—A practical view of rating reform: *D. M. Leech*. Budget planning: A comment, followed by a note by Sir Gwilym Gibbon: *Joan Robinson*. Government: Its personnel and machinery: *Sir Gwilym Gibbon*.

*Review of Economic Studies*, November 1941—Protection and real wages: *Wolfgang F. Stolper* and *Paul A. Samuelson*. Family budget data and price-elasticities of demand: *C. E. V. Lesser*. The burden of death duties in terms of an annual tax: *Tibor Barna*.

UNITED KINGDOM—*Contd.*

*Royal Society of Edinburgh, Proceedings*—1941–42, Part II—On the estimation of statistical parameters: *A. C. Aitken* and *H. Silverstone*.

*Sociological Review, July–October* 1941—The influence of economic conditions on crime—II: *L. Radzinowicz*.

## AFRICA—

*South African Journal of Economics, December* 1941—Southern Rhodesia life tables, No. 1 (European): *J. R. H. Shaul*. American Government finance, 1930–1940: *Mark C. Mills*. Gold and post-war currency standards: *J. N. Reedman*.

## UNITED STATES—

*American Statistical Association Bulletin, March* 1942—Possibilities of greater uniformity in base periods of Government indexes.

*Annals of Mathematical Statistics, March* 1942—Some recent advances in mathematical statistics, I: *Burton Camp*. Some recent advances in mathematical statistics, II: *C. C. Craig*. Distributions in stratified sampling: *Paul H. Anderson*. Serial correlation and quadratic forms in normal variables: *Tjalling Koopmans*. A generalized analysis of variance: *Franklin E. Satterthwaite*. Distribution of the serial correlation coefficient: *R. L. Anderson*. Solution of a mathematical problem connected with the theory of heredity: *S. Bernstein*.

*Econometrica*—

*January* 1942—The stability of equilibrium: Linear and nonlinear systems: *Paul A. Samuelson*. Identity and stability in economics: A survey: *J. Marschak*. Quotations on commodity futures as price forecasts: *Holbrook Working*.

*April* 1942—Paradoxes in taxing savings: *Irving Fisher*. Critical remarks on some business-cycle theories: *J. Tinbergen*. Underemployment equilibrium in international trade: *Lloyd A. Metzler*.

*Experimental Education, Journal of, December* 1941—Seasonal variations in I.Q.: *Harold E. Jones*.

*Federal Reserve Bulletin, April* 1942—Recent changes in the demand for currency. Corporate earnings and dividends.

*Harvard Business Review, Spring Number* 1942—Effect of size on efficiency: *Robert N. Anthony*. Antitrust war policy and full production: *Thurman Arnold* and *J. Sterling Livingston*.

*Journal of Political Economy*—

*December* 1941—The future role of large-scale enterprise: *Theodore O. Yntema*. The role of the individual in the economic world of the future: *Frank H. Knight*. The relation of Government to the economy of the future: *J. M. Clark*.

*February* 1942—"Bargaining power" and market structures: *J. T. Dunlop* and *Benjamin Higgins*. The British White Paper on war finance and national income and expenditure: *Seymour E. Harris*. Marginal cost and dynamic equilibrium of the firm: *Alfred C. Neal*. Modernized cameralism in the Third Reich: The case of the national industry group: *Robert A. Brady*.

*Milbank Memorial Fund Quarterly, January* 1942—Medical evaluation of nutritional status. Social environment as a modifying factor in the correlation between maternal age and intelligence of offspring: *Pearl Moshinsky*. Australia's population problem: *G. F. McCleary*. The importance of family problems in the control of tuberculosis: *Jean Downes* and *Clara R. Price*.

## UNITED STATES—Contd.

*Quarterly Journal of Economics*, February 1942—After unemployment benefits are exhausted: *Charles A. Myers* and *W. Rupert Maclaurin*. Spatial competition in a discontinuous market: *Gardner Ackley*. The operation and regulation of crude oil and gasoline pipe lines: *Roy A. Prewitt*.

*Review of Economic Statistics*, February 1942—Estimates of savings of American families: *Rufus S. Tucker*. Does consumption lag behind incomes? *J. Tinbergen*.

*Social Research*, February 1942—Women's work in Russia's planned economy: *Judith Grunfeld*. Subcontracting in German defense industries: *Herbert Block*.

## INTERNATIONAL—

*International Labour Review*—

*March* 1942—Long-term unemployment in Great Britain: The work of the review panels. Housing policy in wartime and reconstruction: *Carl Major Wright*.

*April* 1942—Labour redistribution in Germany: The work of the employment service. Labour redistribution of war industry: *P. Waelbroeck*.

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## LIST OF ADDITIONS TO THE LIBRARY

Since the issue of Part IV, 1941, the Society has received the publications enumerated below:—

## I.—OFFICIAL PUBLICATIONS

## (a) United Kingdom.

*Agriculture and Fisheries, Ministry of.* Bulletin No. 124. The composition and nutritive value of feeding stuffs. *H. E. Woodman.* London: H.M.S.O., 1942. 9½" × 6". 22 pp. 6d.

*Colonial Office.* Agriculture in the West Indies, compiled from documents supplied to the West India Royal Commission, 1938–39, and other sources. London: H.M.S.O., 1942. 9½" × 6". vi + 280 pp. 10s. 6d.

*Food, Ministry of.* Retail Prices (Notices) Order, 1942. Part I, List of retail controlled prices for grocers and provision merchants. Part II, List of foods included in the "points" rationing scheme. London: H.M.S.O., 1942. 8¼" × 6½". 40 pp. Supplement "A," 6 pp. Supplement "B," 4 pp. 6d.

*Health, Ministry of.*

The care of the homeless. London: H.M.S.O., 1942. 7" × 4½". 48 pp. 6d.

The feeding of children from one to five years. London: H.M.S.O., 8½" × 5½". 18 pp. 4d.

Summary report by the Ministry of Health for the period from 1st April, 1939, to 31st March, 1941. London: H.M.S.O., 1942. Cmd. 6340. 9½" × 6". 52 pp. 9d.

*India Office.* India (Lord Privy Seal's Mission) Statement and draft declaration by His Majesty's Government with correspondence and resolutions connected therewith. London: H.M.S.O., 1942. Cmd. 6350. 9½" × 6". 30 pp. 6d.

*Labour and National Service, Ministry of.* Committee on Skilled Men in the Services. Second report and a memorandum by the War Office. London: H.M.S.O., 1942. Cmd. 6339. 9½" × 6". 74 pp. 1s. 3d.

*Medical Research Council, Industrial Health Research Board.* Emergency report No. 2. Hours of work, lost time and labour wastage. London: H.M.S.O., 1942. 9½" × 6". 26 pp. 6d.

*Parliament.*

Parliamentary debates: official report . . . House of Commons. 5th series, vol. 258, 1930–31 to vol. 308, 1935–36. London: H.M.S.O., 1930–36. 9½" × 6". 51 vols.

Parliamentary debates: official report . . . House of Lords. 5th series, vol. 83, 1931–32 to vol. 97, 1934–35. London: H.M.S.O., 1931–35. 9½" × 6". 15 vols.

*Select Committee on National Expenditure,* Session 1941–42. Reports: 1st, 48 pp., 9d. 2nd, 5 pp., 1d. 3rd, 10 pp., 2d. 4th, 6 pp., 1d. 5th, 18 pp., 3d. 6th, 10 pp., 2d. 7th, 36 pp., 6d. 8th, 18 pp., 3d. London: H.M.S.O., 1942. 9½" × 6". 8 parts.

*Trade, Board of.*

Cloth and clothing coupons and quotas: clothes rationing manual for manufacturers, makers-up, wholesalers and retail traders. London: H.M.S.O., 1942. 7" × 4½". 84 pp. 1s.

Fuel rationing. Report by *Sir William Beveridge*, to the President of the Board of Trade. London: H.M.S.O., 1942. Cmd. 6352. 9½" × 6". 12 pp. 2d.

Retail Trade Committee. Second interim report: the impact of the war on the retail trades in goods other than food. London: H.M.S.O., 1942. 9½" × 6". 40 pp. 6d.

*Treasury.* The taxation of weekly wage earners. London: H.M.S.O., 1942. Cmd. 6348. 9½" × 6". 16 pp. 3d.

*Works and Buildings, Ministry of.*

First report of the Committee on the Brick Industry. London: H.M.S.O., 1942. 9½" × 6". 25 pp. 6d.

Payment by results: trade operations for which bonus rates have been fixed. Memorandum on Essential Work (Building and Civil Engineering) Order 1941. London: H.M.S.O., 1942. 9½" × 6". 20 pp. 4d.

## (b) British Empire.

**Australia—**

Australia: official handbook. Melbourne: Issued with the authority of the Minister for Commerce by the Australian National Publicity Association, 1941.  $9\frac{1}{2}" \times 7"$ . 140 pp.

**Eire—**

*Department of Industry and Commerce.*

Ireland. Census of population 1936, vol. VI, Industrial status. Dublin: Stationery Office, 1941.  $10" \times 6\frac{3}{4}"$ . x + 160 pp. 2s. 6d.

Some statistics of wages and hours of work in 1941, with comparative figures for certain previous years. Dublin: 1942.  $9\frac{1}{2}" \times 6"$ . 79 pp. 1s. 6d.

**India—**

Annual financial statements for the official years 1860-61 to 1873-74, with appendices. Calcutta: 1873.  $9\frac{1}{2}" \times 6"$ . 486 pp. (From Dr. C. O. George.)

**Palestine—**

*Jewish Agency for Palestine. Economic Research Institute.* National income and outlay in Palestine, 1936, by Ludwig Gruenbaum. Jerusalem: 1941.  $9\frac{1}{4}" \times 6"$ . vii + 112 pp.

## (c) Foreign Countries.

**Czechoslovakia—**

*Ministry of Foreign Affairs, Department of Information.* Statistical handbook of the Czechoslovak Republic. London: [1942].  $9\frac{3}{4}" \times 6"$ . viii + 157 pp.

**Spain—**

*Ministerio de Trabajo. Dirección General de Estadística.* Anuario estadístico de España. edición manual. Madrid: 1941.  $6" \times 4\frac{1}{4}"$ . xvi + 521 pp.

**Switzerland—**

*Bureau Fédéral de Statistique.*

Contribution fédérale de crise; résultats de la III<sup>me</sup> période 1938-1939. Administration fédérale des contributions. Bern: 1941.  $11\frac{1}{4}" \times 8\frac{1}{4}"$ . v + 74 pp.

Recensement fédéral de la population. 1<sup>er</sup> décembre 1941; population de résidence des communes. Résultats provisoires. Bern: 1942.  $8\frac{1}{4}" \times 5\frac{1}{4}"$ . 7 + [1] + 50 pp.

## (d) International.

**International Labour Office—**

Studies and reports, Series D., No. 23. Labour conditions in war contracts, with special reference to Canada, Great Britain and the United States. Montreal: 1942.  $9\frac{1}{2}" \times 6\frac{1}{4}"$ . iii + 59 pp. 1s.

— Series M., No. 18. Approaches to social security: an international survey. Montreal: 1942.  $9\frac{1}{4}" \times 6\frac{1}{4}"$ . iii + 100 pp. 2s.

**League of Nations—**

*Economic Intelligence Service.* Statistical year-book of the League of Nations, 1940/41. Geneva: 1941.  $9\frac{1}{2}" \times 7\frac{1}{4}"$ . 271 pp. 10s.

## II.—AUTHORS AND MISCELLANEOUS

*Allcock (H. J.) and Jones (J. Reginald).* The nomogram: the theory and practical construction of computation charts. 3rd ed. London: Pitman, 1941.  $8\frac{1}{2}" \times 5\frac{1}{2}"$ . viii + 224 pp. 10s. 6d.

Association for Planning and Regional Reconstruction. Broadsheet. Nos. 1-8, 1942. London: 1942.  $10\frac{1}{2}" \times 6"$ . 8 parts.

## II.—Authors and Miscellaneous—Contd.

- Bassett (H. H.)*. British commerce. (The Nations Library.) London: Collins, 1913.  $6\frac{1}{2}'' \times 4''$ . 263 pp. (From Dr. C. O. George.)
- Borden (Neil H.)*. The economic effects of advertising. Chicago: Richard D. Irwin, Inc., 1942.  $9'' \times 6''$ . xl + 988 pp. \$5.
- Braatoy (Bjarne)*. Labour and war: the theory of labour action to prevent war. . . . Preface by *Harold J. Laski*. London: Allen & Unwin, 1934.  $8\frac{3}{4}'' \times 5\frac{1}{2}''$ . 216 pp. (From Dr. C. O. George.)
- British Standards Institution. Guide for quality control and control chart method of analysing data. American Defence Emergency Standards, reproduced by courtesy of the American Standards Association, New York. (B.S. 1008: 1942.) London: 1942.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . 49 pp. 3s. 6d.
- Cheeseman (E. A.)*. Comparison between the direct and indirect occupational risk in mortality from pulmonary tuberculosis. (Reprint from the *Journal of Hygiene*, xli, 1942, pp. 464-72.) London:  $10'' \times 7''$ . (From the author.)
- Clark (G. N.)*. Belgium and the war. (Oxford Pamphlet on World Affairs, No. 56.) London: Oxford University Press, 1942.  $7\frac{1}{4}'' \times 4\frac{3}{4}''$ . 32 pp. 4d.
- Croxtan (Frederick E.)* and *Cowden (Dudley J.)*. Applied general statistics. New York: 1939 (London: Pitman).  $9'' \times 6''$ , xviii + 944 + xiii pp. 20s.
- Davis (Harold T.)*. The analysis of economic time series. (The Cowles Commission for Research in Economics, Monograph No. 6). Bloomington, Indiana: Principia Press, 1941.  $9\frac{1}{2}'' \times 6\frac{1}{2}''$ . xiv + 620 pp. \$3.
- Dean (Joel)*. The relation of cost to output for a leather belt shop, by *Joel Dean*, with a memorandum on certain problems in the empirical study of costs, by *C. Reinold Noyes*. (Technical Paper, 2, Dec. 1941.) New York: National Bureau of Economic Research.  $11\frac{1}{4}'' \times 7\frac{1}{4}''$ . 72 pp.
- Dublin (Louis I.)* and *Spiegelman (Mortimer)*. Current versus generation life tables. (Reprinted from *Human Biology*, Dec. 1941.)  $9\frac{1}{2}'' \times 6''$ . 18 pp. (From the authors.)
- Dudding (B. P.)* and *Jennett (W. J.)*. Quality control charts: being Part I of a revision of B.S. 600: 1935, The application of statistical methods to industrial standardisation and quality control [by *E. S. Pearson*] (B.S. 600R: 1942). London: British Standards Institution, 1942.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . 85 pp. 3s. 6d.
- Due (John F.)*. The theory of incidence of sales taxation. New York: King's Crown Press, 1942.  $10\frac{1}{4}'' \times 8\frac{1}{4}''$ . xii + 257 pp. \$2.25.
- East (W. Norwood)*. The adolescent criminal: a medical-sociological study of 4,000 male adolescents, by *W. Norwood East* . . . in collaboration with *Percy Stocks* . . . and *H. T. P. Young* . . . with a foreword by *Sir Arthur Maxwell*. London: J. & A. Churchill, 1942.  $9\frac{3}{4}'' \times 7\frac{1}{4}''$ . xi + 327 pp. 45s.
- Elsas (M. J.)*. Housing before the war and after. London: P. S. King, 1942.  $8\frac{1}{2}'' \times 6''$ . ix + 69 pp. 5s.
- Fisher (R. A.)*. The asymptotic approach to Behrens's integral, with further tables for the *d* test of significance. (Reprinted from *Annals of Eugenics*, Vol. 11, pt. 2, pp. 141-72, 1941.)
- The negative binomial distribution. (Reprinted from *Annals of Eugenics*, vol. 11, pt. 2, pp. 182-87, 1941.) London:  $10\frac{1}{4}'' \times 8''$ . (From the author.)
- Gilchrist (R. N.)*. Principles of political science. Bombay & London: Longmans Green, 1921.  $7\frac{1}{4}'' \times 5\frac{1}{4}''$ . xi + 799 + li pp. (From Dr. Bradford Hill.)
- Greenwood (Major)*. Medical statistics from Graunt to Farr: Part I. (Reprinted from *Biometrika*, Oct. 1941, pp. 102-27.) London:  $10\frac{3}{4}'' \times 7\frac{1}{4}''$ .
- and *Teleky (A.)*. Medical graduation at Cambridge; a statistical note. (Reprinted from *The Lancet*, Jan. 17th, 1942, p. 63.) London: 1942.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . 4 pp. (From the authors.)
- Henry (F.)*. It is a fine day today, or the theory of money. London: P. S. King, 1942.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . 101 pp. 7s. 6d.
- Inland Revenue Staff Federation. Deduction of income tax from earnings: suggested schemes for improving the present method. Report of joint committee of Association of H.M. Inspectors of Taxes and Inland Revenue Staff Federation. London: 1942.  $8\frac{1}{2}'' \times 5\frac{1}{4}''$ . 40 pp.
- Institution of Mechanical Engineers. Discussion on the application of statistical control to the quality of materials and manufactured products. (In *Journal and proceedings*, June 1942, pp. 125-44.) London: 1942.  $11'' \times 8\frac{1}{2}''$ . (From the Institution.)

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- Key (Helmer)*. The new colonial policy . . . translated from the Swedish by *E. Classen*. London: Methuen, 1927.  $7\frac{1}{2}" \times 5"$ . viii + 214 pp. (From Dr. C. O. George.)
- Kuznets (Simon)*. National income and its composition, 1919-38, by *Simon Kuznets*, assisted by *Lilian Epstein* and *Elizabeth Jenks*. (Publications of the National Bureau of Economic Research, No. 40.) New York: 1941.  $9" \times 6"$ . 2 vols. \$5.
- Lowell (A. Lawrence)*. The government of England. . . . New edition with additional chapter. New York & London: Macmillan, 1920.  $8\frac{1}{4}" \times 6"$ . 2 vols. (From Dr. Bradford Hill.)
- Mason (D. M.)*. Six years of politics, 1910-16; containing speeches on finance, foreign affairs, home rule, and women's suffrage. . . . London: John Murray, 1917.  $7\frac{1}{4}" \times 5"$ . ix + 218 pp. (From Dr. C. O. George.)
- Paish (Sir George)*. The road to prosperity. London: Ernest Benn, 1927.  $8\frac{1}{2}" \times 5\frac{1}{4}"$ . vii + 154 pp. (From Dr. C. O. George.)
- Phillips (H. S.)*. Municipal efficiency and town size. (In *Journal of the Town Planning Institute*, May-June 1942, pp. 139-48.) London: 1942.  $11" \times 8\frac{1}{2}"$ . (From the author.)
- Prager (T.) and Wilkinson (M. J.)*. The industrial front in Germany: a review of working conditions and social welfare in Germany since the war. (Reprinted from *Labour Management*, Jan. 1942.)  $11" \times 8\frac{1}{2}"$ . 6 pp. (From the author.)
- Robinson (Joan)*. An essay on Marxian economics. London: Macmillan, 1942. x + 122 pp. 7s. 6d.
- Root (J. W.)*. British national finance. London: Eyre & Spottiswoode, 1909.  $8\frac{1}{2}" \times 5\frac{1}{2}"$ . viii + 203 pp.
- Tariff and trade. Liverpool: Allott, Jones & Co., 1898.  $8\frac{1}{2}" \times 5\frac{1}{2}"$ . xv + 452 pp. (From Dr. C. O. George.)
- Scientific Computing Service. Table of squares of all numbers less than 300. London: 1942.  $9" \times 6\frac{1}{2}"$ . 2 pp. 1s.
- Thomson (J. Arthur)*. Introduction to science. (Home University Library.) London: Thornton Butterworth, 1934.  $6\frac{1}{2}" \times 4"$ . v + 256 pp. (From Dr. C. O. George.)
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- and *Robinson (G.)*. The calculus of observations: a treatise on numerical mathematics. London: Blackie, 1924.  $8\frac{1}{2}" \times 6"$ . xvi + 395 pp. (From Dr. Bradford Hill.)
- Wolfenden (Hugh H.)* The fundamental principles of mathematical statistics; with special reference to the requirements of actuaries and vital statisticians, and an outline of a course in graduation. Toronto: for the Actuarial Society of America, New York, by Macmillan Co., 1942.  $8\frac{1}{2}" \times 5\frac{1}{2}"$ . xv + 379 pp. \$5.
- Woytinsky (W. S.)*. Three aspects of labor dynamics: a report prepared for the Committee on Social Security. Washington: Social Science Research Council, 1942.  $9" \times 6"$ . xiv + 249 pp. \$2.50.
- Yates (P. Lamartine)*. Food production in Western Europe: an economic survey of agriculture in six countries . . . being the report of an inquiry organized by Viscount Aston and B. Seeböhm Rowntree. Foreword by Sir William Beveridge. London: Longmans Green, 1940.  $9\frac{1}{4}" \times 6\frac{1}{4}"$ . xv + 572 pp. 15s.

## REVENUE OF THE UNITED KINGDOM

*Net Produce in Quarters of 1941, and in Financial Years ended  
March 31, 1940-41, 1939-40, 1938-39, 1937-38*

(000's omitted)

QUARTERS, ended	March 31, 1941	June 30, 1941	Sept. 30, 1941	Dec. 31, 1941	Total for calendar year 1941
	£	£	£	£	£
Customs ... ..	78,419	81,650	93,009	96,604	349,682
Excise ... ..	81,114	56,800	100,800	81,800	323,514
Stamps and Estate etc. Duties ... ..	25,977	26,426	26,005	23,186	101,594
Other Inland Revenue Duties ... ..	667	125	60	92	944
Post Office ... ..	28,790	26,100	26,800	33,400	115,090
National Defence Contribution ... ..	7,850	4,004	5,691	5,639	23,184
Excess Profits Tax ... ..	28,320	40,595	58,900	80,076	207,891
	251,137	235,700	311,265	323,797	1,121,899
Income Tax and Surtax ... ..	389,709	87,456	103,055	160,131	740,351
	640,846	323,156	414,320	483,928	1,862,250
Motor Vehicle Duties ... ..	24,858	4,898	4,448	3,484	37,688
Crown Lands ... ..	260	280	250	180	970
Interest on Sundry Loans ... ..	1,583	807	1,167	984	4,541
Miscellaneous Receipts ... ..	9,219	14,517	22,258	23,790	69,784
	676,766	343,658	442,443	512,366	1,975,233

YEARS, ended March 31	1940-41	1939-40	1940-41 (compared with 1939-40)		Corresponding years	
			Increase	Decrease	1938-39	1937-38
	£	£	£	£	£	£
Customs ... ..	304,939	262,136	42,803	—	226,326	221,561
Excise ... ..	224,100	137,900	86,200	—	114,200	113,700
Stamps and Estate etc. Duties ... ..	94,455	94,790	—	335	98,410	113,150
Other Inland Revenue Duties ... ..	1,015	1,300	—	285	1,550	1,730
Post Office ... ..	101,710	88,657	13,053	—	89,850	87,375
National Defence Contribution ... ..	24,085	26,940	—	2,855	21,890	1,420
Excess Profits Tax ... ..	72,103	40	72,063	—	—	—
	822,437	611,763	214,149	3,475	552,226	538,936
Income Tax and Supertax ... ..	600,056	459,863	140,193	—	398,431	355,046
	1,422,493	1,071,626	354,342	3,475	950,657	893,982
Motor Vehicle Duties ... ..	38,006	34,086	3,920	—	35,608	34,608
Crown Lands ... ..	1,100	1,250	—	150	1,330	1,330
Interest on Sunday Loans ... ..	2,553	4,916	—	2,363	5,699	5,230
Miscellaneous Receipts ... ..	31,132	20,364	10,768	—	12,941	13,509
	1,495,284	1,132,242	369,030	5,988	1,006,235	948,659
Total ... ..			NET. INCR. 363,042			



**BANK OF ENGLAND**  
*Pursuant to the Act 7th and 8th Victoria, cap. 32 (1844),*  
 (000's omitted)

1	2	3	4	5	6	7	8
ISSUE DEPARTMENT						COLLATERAL COLUMNS	
Liabilities	DATES	Assets				Notes in Hands of Public	Minimum Discount Rate
Notes Issued.	(Wednesdays)	Govt. Debt (£11,015) and Govt. Securities	Other Securities	Gold Coin and Bullion	Silver Coin		
£		£	£	£	£	£	Per cent.
630,241	Jan. 1.....	626,274	3,715	241	11	615,855	2
630,241	" 8.....	626,411	3,581	241	8	610,452	(Oct. 26, 1939)
630,241	" 15.....	626,456	3,535	241	9	602,843	
630,241	" 22.....	626,351	3,638	241	11	598,426	
630,241	" 29.....	626,260	3,734	241	6	599,203	
630,241	Feb. 5.....	626,775	3,217	241	8	601,052	
630,241	" 12.....	626,838	3,154	241	8	602,032	
630,241	" 19.....	626,768	3,226	241	6	601,476	
630,241	" 26.....	627,036	2,956	241	8	603,240	
630,241	Mar. 5.....	626,952	3,037	241	11	607,278	
630,241	" 12.....	626,998	2,993	241	9	608,420	
630,241	" 19.....	626,934	3,067	241	9	608,420	
630,241	" 26.....	626,975	3,018	241	7	611,484	
630,241	Apr. 2.....	626,986	3,005	241	9	614,630	
630,241	" 9.....	627,025	2,968	241	8	618,718	
630,241	" 16.....	627,052	2,941	241	7	622,203	
630,241	" 23.....	627,080	2,912	241	8	622,450	
630,241	" 30.....	677,181	2,811	241	8	623,349	
630,241	May 7.....	677,160	2,830	241	10	625,972	
630,241	" 14.....	677,239	752	241	9	626,422	
630,241	" 21.....	677,286	2,707	241	7	629,713	
630,241	" 28.....	677,502	2,489	241	9	629,515	
630,241	June 4.....	677,484	2,508	241	8	635,432	
630,241	" 11.....	677,500	2,494	241	6	637,168	
630,241	" 18.....	677,595	2,392	241	13	637,531	
680,241	" 25.....	677,250	2,491	241	259	638,984	
680,241	July 2.....	677,501	2,241	241	258	643,365	
680,241	" 9.....	677,450	2,288	241	262	648,029	
680,241	" 16.....	677,453	2,286	241	261	650,920	
680,241	" 23.....	677,463	2,278	241	259	652,655	
680,241	" 30.....	677,572	2,171	241	257	658,430	
680,241	Aug. 6.....	677,695	2,044	241	261	677,694	
680,241	" 13.....	677,751	1,992	241	257	668,177	
680,241	" 20.....	677,689	2,051	241	260	665,375	
680,241	" 27.....	677,672	2,069	241	259	664,702	
730,241	Sept. 3.....	727,469	2,019	241	512	667,257	
730,241	" 10.....	727,373	2,120	241	507	669,404	
730,241	" 17.....	727,423	2,063	241	514	669,739	
730,241	" 24.....	727,466	2,018	241	516	671,392	
730,241	Oct. 1.....	727,430	2,063	241	507	677,774	
730,241	" 8.....	727,472	2,019	241	509	683,319	
730,241	" 15.....	727,478	2,012	241	510	686,063	
730,241	" 22.....	727,291	2,203	241	506	688,528	
730,241	" 29.....	727,329	2,161	241	510	693,327	
730,241	Nov. 5.....	727,256	2,227	241	517	699,949	
730,241	" 12.....	727,320	2,186	241	514	704,035	
730,241	" 19.....	727,173	2,315	241	512	706,697	
730,241	" 26.....	727,303	2,179	241	518	710,042	
780,241	Dec. 3.....	777,809	2,171	241	20	716,848	
780,241	" 10.....	777,880	2,102	241	18	726,592	
780,241	" 17.....	777,895	2,093	241	12	740,059	
780,241	" 24.....	777,949	2,088	241	13	751,244	
780,241	" 31.....	777,979	2,003	241	18	751,726	

## WEEKLY RETURN

for Wednesday in each Week, during the Year 1941

(000's omitted)

9	10	11	12	13	14	15	16	17	18
BANKING DEPARTMENT									
Liabilities				DATES	Assets				Totals of Liabilities and Assets
Capital (£14,553 and Rest	Public Deposits	Bankers' Deposits	Other Deposits	(Wednesdays)	Govt. Securities	Dis-counts and Advances	Other Securities	Reserve (Notes and Coin)	
£	£	£	£		£	£	£	£	£
17,885	17,568	181,024	52,870	Jan. 1	224,853	5,595	23,612	15,287	269,347
17,906	15,883	139,315	56,246	" 8	173,003	5,523	21,234	20,590	220,350
17,932	14,789	119,203	54,306	" 15	152,513	3,719	22,038	28,160	206,230
17,949	35,309	95,127	52,538	" 22	142,983	3,844	21,411	32,685	200,923
17,975	32,374	107,884	53,005	" 29	119,948	3,818	25,458	32,014	211,238
17,992	13,836	110,801	51,665	Feb. 5	141,203	3,333	19,515	30,243	194,294
18,018	23,941	110,628	55,175	" 12	154,883	2,713	19,815	29,351	207,762
18,046	31,751	103,471	52,371	" 19	152,138	3,791	19,667	30,043	205,639
18,071	14,935	121,722	53,017	" 26	156,373	3,723	18,978	28,371	207,445
18,082	11,737	125,382	53,729	Mar. 5	157,843	5,985	20,831	24,271	208,930
18,088	13,441	110,117	53,992	" 12	146,283	5,999	20,272	23,084	195,638
18,096	14,742	95,187	52,053	" 19	129,833	6,145	21,045	23,055	180,078
18,116	21,976	118,597	52,288	" 26	126,508	15,275	19,335	19,859	210,977
18,126	22,236	101,452	55,244	Apr. 2	124,543	36,814	19,133	16,568	197,058
17,655	18,720	110,082	53,305	" 9	127,973	39,913	19,313	12,563	199,762
17,671	14,871	115,145	53,411	" 16	132,688	40,784	18,396	9,230	201,098
17,686	16,125	112,622	52,207	" 23	132,173	38,238	19,072	9,057	198,540
17,701	13,648	131,755	57,240	" 30	109,308	28,314	24,380	58,262	220,344
17,718	12,237	113,556	53,963	May 7	102,478	19,351	19,790	55,855	197,474
17,733	14,408	115,520	52,110	" 14	115,303	12,249	19,753	52,166	199,771
17,750	39,857	96,583	51,692	" 21	121,568	12,569	19,583	52,173	205,882
17,767	32,333	110,904	52,129	" 28	125,293	11,438	24,152	52,330	
17,775	10,030	121,866	52,053	June 4	130,313	6,449	19,333	46,529	202,622
17,794	7,040	122,668	52,301	" 11	129,088	5,098	19,818	41,799	198,803
17,812	9,811	122,415	51,671	" 18	132,713	5,132	19,304	44,530	201,709
17,833	25,329	112,537	50,454	" 25	137,943	6,912	18,258	42,931	206,044
17,849	12,251	161,443	53,161	July 2	182,343	8,101	18,440	38,520	247,704
17,857	10,528	131,791	52,395	" 9	152,808	7,438	18,474	33,914	212,574
17,888	28,881	108,108	50,155	" 16	142,843	11,568	19,548	30,073	205,032
17,911	14,127	124,345	49,275	" 23	146,933	10,316	19,155	29,254	205,058
17,924	11,286	132,081	50,520	" 30	158,773	6,545	22,972	23,521	211,811
17,943	17,907	108,850	49,396	Aug. 6	156,118	3,608	19,423	11,947	194,096
17,963	37,673	96,127	49,322	" 13	162,203	6,246	18,844	13,792	201,085
17,983	35,617	102,610	48,611	" 20	161,953	6,471	19,812	16,615	204,851
18,000	14,863	125,066	49,108	" 27	160,343	6,388	23,007	17,299	207,637
18,015	14,498	122,677	53,012	Sept. 3	115,923	7,086	20,633	64,560	208,202
18,023	9,275	133,776	53,008	" 10	125,353	5,312	21,071	62,346	214,082
18,040	10,799	127,629	51,522	" 17	120,223	5,141	20,597	62,029	207,990
18,051	10,637	133,915	52,239	" 24	129,058	4,602	20,702	60,480	214,842
18,073	12,428	122,336	54,644	Oct. 1	124,583	3,668	25,247	53,983	207,481
17,644	12,200	126,468	53,733	" 8	138,518	3,000	20,198	48,335	210,051
17,655	11,127	128,218	54,394	" 15	141,945	2,805	21,047	45,694	211,394
17,672	21,304	116,804	56,040	" 22	142,183	5,362	21,202	43,073	211,820
17,687	13,723	116,961	57,678	" 29	135,993	4,496	27,350	38,210	206,049
17,703	10,531	120,013	54,862	Nov. 5	144,343	3,719	23,555	31,492	203,109
17,717	8,362	138,941	52,634	" 12	161,223	3,128	23,114	27,192	217,657
17,738	10,619	120,048	52,971	" 19	150,878	3,033	23,070	24,395	201,376
17,757	9,790	136,429	53,080	" 26	170,683	3,973	21,580	20,820	217,056
17,769	7,599	136,349	55,961	Dec. 3	126,903	4,556	21,807	64,412	217,678
17,787	7,766	129,044	55,764	" 10	128,868	4,117	22,889	54,487	210,361
17,809	10,740	121,061	53,608	" 17	135,658	3,644	23,170	40,846	203,318
17,828	9,986	138,185	54,622	" 24	165,083	2,906	23,213	29,319	220,621
17,850	11,227	219,865	54,072	" 31	210,603	6,365	27,233	28,813	303,014



# JOURNAL OF THE ROYAL STATISTICAL SOCIETY

## PART II, 1942.

### ON THE FUTURE OF STATISTICS

By M. G. KENDALL

[Read before the ROYAL STATISTICAL SOCIETY, April 21st, 1942,  
PROFESSOR M. GREENWOOD, F.R.S., in the Chair].

#### INTRODUCTION

AT a time when everyone is thinking of the new world which we shall have to build after the war, we are justified in considering what will happen to the science of statistics in the next thirty or forty years, and what contribution that science can make to human progress. In this paper I want to advance a few ideas on this subject, in the hope that contributors to the discussion may be stimulated to expressing their own. We statisticians, I suppose, are naturally diffident about extrapolating from the experience of the past into the future; but in present conditions it is not merely a pleasure but a duty that we should try to coax from the chaos of pre-ordination some general notions of the paths along which statistical science and institutions will develop.

The most convenient point of entry into the subject is a consideration of the future scope of the theory of statistics. Perhaps it will be felt that a definition of that theory is required; and if so, I should define statistics as the branch of scientific method which deals with the numerical aspects of aggregates of natural phenomena. But I am not at all sure that a complete definition is either possible or desirable. To adapt a famous definition of geometry: statistics is what statisticians do; and perhaps we can leave it at that.

The question is, what will statisticians be doing in the next few decades? Beginning as a small sect concerned only with political economy, they have already overrun every branch of science with a rapidity of conquest rivalled only by Attila, Mohammed and the Colorado beetle. They have ousted mathematics from its position as the matrix of the sciences, and they are beginning to appear among the arts.\* They have obtained a foothold in commerce; several big firms run their own statistical departments, and others consult statisticians for guidance in their affairs, as they consult lawyers or chartered accountants. The scope of their activities thus ranges from the day-to-day operations of ordinary business to the most abstract branches of pure mathematics, and, enormous as it already is, must, I think, extend even farther. We

\* Mr. Udny Yule, for example, has settled some points of disputed authorship by reference to sentence length as a characteristic of prose style. The proportion of feminine endings in blank verse has been used to date Shakespeare's plays. Life-tables have been used to throw doubt on the chronology of early Roman history. The frequency of brush-marks has been used to authenticate paintings. Up to the present, architecture and music have escaped, but who would venture to prophesy how long they will continue to do so?

may look forward to the time when statistics is taught in schools; when it is an honourable and populous profession, with perhaps a Trades Union; when professors of statistics outnumber professors of divinity; when every sizeable business firm includes a statistician among its retinue, much as every notable family in the eighteenth century had its own chaplain; when the man in the train who begins his remarks with "Of course, I am not a statistician" does so with a sense of humility and not, as at present, with an air of quiet satisfaction at freedom from a serious mental disfigurement.

The extent of the domain open to our consideration is a little frightening, and I shall not attempt to cover it all. I propose to deal only with the future of statistics as a branch of scientific method and with some aspects of statistical organization. If the Society feels that there is some useful purpose (as I think there is) in considering the future of certain branches of our subject in more detail, no doubt, as they say in official circles, the appropriate officers will take the requisite action on the next suitable occasion.

### SOME FUTURE TRENDS IN THE THEORY OF STATISTICS

#### *An increase in specialization*

Looking at the domain of statistical theory as a whole, we have first, I think, to recognize the necessity for an increasing amount of specialization. Even to-day it is quite impossible to read everything that is published on the theory, and difficult enough to read that part of it which is worth reading. Workers in different fields manage to learn vaguely what is going on elsewhere by glancing through periodical publications, attending meetings of statistical societies, holding occasional conventions and following other scientific techniques for lubricating the interchange of ideas. But the time has gone when one could keep pace with every development. It is an unfortunate but an inevitable thing that the struggle for scientific recognition compels an ever greater degree of specialization.

We must therefore expect that in the next few decades there will grow up several distinct branches of statistical theory and several distinct types of statistician. We have already seen a simple fission of the primordial statistical polymath into a "theoretical" and a "practising" statistician.\* The mitotic process will continue. At one end of the scale we shall have the statistical logician, concerned with the pure theory of inference. Then there will be the mathematician who solves problems in pure mathematics phrased in statistical language; then the statistician who solves statistical problems in mathematical language; and finally the statistician whose problems are not mathematical at all, but have to be solved by common sense and rule of thumb. Classifying in rather a different way, we may expect the appearance of a sort of general practitioner and of the specialist in certain subjects, such as the sampling of human populations. There may even arise distinct ancillary trades, such as statistical computers and experiment-designers.

All this presumably makes for the greater efficiency of the collective human organism and, since the process appears to be quite inescapable, there is not much point in discussing whether it is desirable or not. I wish to offer only two comments. The first is that it may exert a profound effect on the structure

\* There are a few giants even in these days who are equally at home in the theoretical and practical fields, and we may hope that the race will never become entirely extinct.

of the Royal Statistical Society itself (a matter to which I return later). The second is that I think we ought to clear the air a little about the future place of mathematics in the theory of statistics.

*The place of mathematics in the theory of statistics*

The mathematician is less concerned with the truth of what he says than with the question whether it follows accurately from his assumptions. The statistician, on the other hand, is concerned with the discovery of facts about the physical world and their interpretation. The consequence is that the two find themselves occasionally in conflict, or perhaps it would be better to say arguing from different premisses. The point is seen most clearly in the theory of small samples, which is regarded by many statisticians with some considerable disfavour. The mathematician is perfectly correct in saying that certain inferences follow from certain samples provided they are random. The practising statistician, who in many cases has obtained the sample and knows that there is a substantial possibility of its being biased, is perfectly correct in discounting the inferences on that ground. The unfortunate feature of the situation is that, on the principle that any stigma will do to beat a dogma, each side tends to belittle the labours of the other on all kinds of grounds or on no grounds at all. The mathematician is apt to feel himself slighted and to suspect that his methods are aspersed solely because they are not understood; and the statistician is apt to regard mathematicians as the self-elected Illuminati of a cult which may indeed satisfy some inner craving for mystical experience, but has no material contribution to offer to human advancement. If this kind of antagonism grows it may prove a serious handicap to progress, not to say peace and goodwill, among statisticians generally. I hope I shall not be thought impertinent if I appeal for a greater measure of mutual understanding on this matter. Mathematics plays a great and growing part in statistical theory, and there could be no theory without it, but that theory is no more a branch of mathematics than is engineering or astronomy; and this I maintain in the full knowledge that I shall probably offend both parties and be ground between the upper and the nether millstone.

*The consolidation of existing knowledge*

We may consider the future of the scope of statistical theory under three heads: the consolidation of work already done, the filling in of gaps in our knowledge on lines already known, and the opening up of new fields altogether. It is not inconsistent with what has been said above to observe that these three movements will not necessarily be carried out by different groups of individuals. Nor need they proceed at the same pace, for there are rhythms in scientific discovery, and the three are not, generally speaking, in step. But I think we can confidently predict substantial progress in all three fields in the next few decades, and it is even possible to foresee some of the directions in which that progress will be made.

In the past fifty years we have experienced a development in the theory of statistics which is familiar in science—the rapid exploration of new territory by the use of non-rigorous methods. There are relatively few of our fundamental memoirs which satisfy the austere standard demanded nowadays by pure mathematicians, even in England. I mean this in no pejorative sense. The function of the pioneer is to blaze a trail and leave other people to make

the highway safe for ordinary pedestrians. But it is right and proper that a period of rapid discovery should be followed by one of rigorization, and I think such a period is due to begin, if indeed it has not already begun. Some of the fundamental theorems of statistics have now been proved in a manner which would satisfy the most exacting standards; for example, Liapounoff's proof of the central limit theorem and Cramér's proof of the conditions of convergence of the Gram-Charlier series. We still require, however, rigorous investigations of the conditions under which maximum likelihood statistics have minimum variance and a number of similar results. Pure mathematicians are by now fully alive to the existence of a new domain awaiting their attention, and we may confidently expect them to turn to it in increasing numbers.

Concurrently with rigorization we may expect a considerable increase in the study of axioms and postulates in statistical theory. At the present time there exists no systematic presentation of the theory at all. In referring to axiomatization I am not to be understood in the mathematical sense. The bases of mathematics have been studied very extensively, and it is always possible, as for example by calling a cumulated frequency a Stieltjes integral, or a probability a set function, to throw back the formal axiomatization of statistics on to that of mathematics.\* But this expedient, though useful to the mathematician, is not one to which the statistician has any right to have recourse. The latter, for instance, wants to know how far it is legitimate to imagine a population round a given sample of field trials and then use those trials to infer the properties of his imaginary population; whether, in fact, in Eddington's expressive adaptation of Defoe, the footprints we keep discovering in the sand may not be our own. What we want at the present time is a Euclid or a Justinian to codify our knowledge and enumerate our axioms and postulates. I personally have no doubt that the occasion will call forth the man and that such work will be carried out in the next few years.

#### *Extension of existing methods*

The second of the three heads referred to above may perhaps be best described in the current jargon as mopping-up operations. Large bodies of the enemy's forces remain in the rear of our advanced elements, and will have to be eliminated. The list is rather a long one, and I need only mention a few outstanding pockets of resistance by way of illustration. We still know very little about analysis of variance in non-normal variation; we know very little about the conditions under which a given function can be a characteristic function; we have not yet found a really satisfactory method of expanding frequency functions in rapidly convergent series; we know next to nothing about the significance of rank correlations in correlated populations. Contributors to the discussion will be able to refer to other gaps in our knowledge, probably of a more interesting character.

In the next ten years or so we shall no doubt see many of these points cleared up; but I am by no means sure that they will be cleared up by an ordinary application or modification of known methods. In this connection I should like to direct attention to the importance of occasionally breaking

\*In this connection I should like to pose to mathematical logicians the following question: can it be shown that the controversy about von Mises' theory of probability is equivalent to that between the formalist and intuitive mathematical schools which has led some writers to deny the universal validity of the law of the excluded middle? I suspect that this is so, but it would be interesting to have an expert opinion.

with tradition and re-framing the question which has to be answered. There have been two notable examples in recent years of the success of this technique: Fisher's introduction of  $k$ -statistics and Neyman and Pearson's development of confidence intervals. As studies in scientific method both deserve very careful attention.

The problem faced by Fisher goes back about fifty years. It was simply to determine the sampling constants of the moments of a sample in terms of those of the parent population. This is a problem which yields to a skilful use of comparatively elementary algebra, and was first solved in complete generality by Tschuprow. But the trouble was that the resulting formulæ were exceedingly long and complicated, so complicated that even their discoverers made mistakes in working them out. Tschuprow made mistakes which were corrected by Church. Church made mistakes which were corrected by Isserlis. And apart altogether from the errors, the sheer length of the results seemed to make them useless for practical purposes. We seemed to be up against a blank wall. In 1929 it was seriously suggested that one of the best prospects of further advance lay in the abandonment of characterizing frequency distributions by moments altogether.

It was at this point that the position was resolved by Fisher in what I personally regard as one of his greatest contributions to modern theory. If the moments of moments themselves led to impossibly cumbrous formulæ, were there any other symmetric functions of the observations which would give simple sampling results? There were: the  $k$ -statistics. By sacrificing simplicity in the statistics considered, a tremendous gain is imported into the sampling formulæ. In fact, the problem was solved by asking a question which was different, but the answer to which gave us what we wanted to know.

Neyman and Pearson have done something of the same kind in the theory of inference. The older type of induction attempted to make statements about the probability of the value of some parameter lying between two specified limits. This led to all kinds of troubles over the postulate known as Bayes'. The essential concept of the theory of confidence intervals, if I have understood it correctly, is the replacement of these specified limits by random variables—that is to say, by functions of the sample numbers. Questions of the type: does the mean of the population lie between two given numbers are replaced by the type: does it lie between certain values of the sample such as the quartiles, whatever they turn out to be? Put in this way, the question avoids the difficulty which has for so long tormented the statistical logician. Once again the difficulty is at least partially resolved by re-framing the question. I am inclined to suspect that many problems now outstanding may yield to this oblique method of approach.\*

### *Some possible new fields of research*

So much for the extension of existing work. I turn now to a rather more hazardous type of prophecy, the forecasting of future developments in new fields. It is difficult if not impossible to prevent one's surmises on this subject from being coloured by hope as well as by expectation, but I propose to deal with three topics in which some development seems inevitable: the study of

\* For example, the distributions of certain statistics, even from simple parents, are very complicated. Can we reverse the problem, and investigate those parents for which the sampling distributions are simple?



biased sampling, the invention of statistical machines, and the settlement of the prolonged wrangle about the theory of probability in statistics.

There can, I think, be no dispute about the proposition that the estimation of properties of a population from a sample is the most important practical problem in statistics and is long likely to continue so. One of the more notable results of the present war will be to convince even Government Departments, who are very conservative in such matters, that rational judgments can be based on samples. In fact, the exigencies of war have compelled sampling on a scale hitherto undreamed of, and, so far as I can judge, will have converted a good many diehards to the belief that the sampling process can properly form the basis of an intelligently formulated policy.

Now, statistical theory at the present time is concerned almost entirely with random sampling. A beginning has been made in the control of error by stratification, but even here sampling within strata is assumed to be random. At the same time, evidence is accumulating to show that many of the methods which were formerly assumed to give a random sample result in a bias which is sometimes serious enough to vitiate them. Our elaborate theory is in danger of relegation to the lecture theatre as being based on assumptions which are not realized in practice.

This is not a matter which can be helped at this stage by additional mathematics. What is wanted is a thorough practical investigation into the nature and prevalence of bias, to discover the laws which govern it. We ought to find out, for example, whether estimators of crops always tend to over-estimate low yields and under-estimate high ones; how far bias varies from one individual to another; whether judgments of size show the same variability as judgments of number; whether reflective judgments are a material improvement on snap judgments; whether the faculty of estimation can be improved by training; whether the method of picking every tenth house in a street does give a representative sample; what are the best techniques for ensuring that in a house-to-house survey replies are extracted from every member on the sample list; and a hundred other matters of the same kind. This is a purely experimental field, almost untouched, waiting to be cultivated. Only when we have accumulated the necessary evidence can we formulate the laws of bias, and it is at that stage that mathematics will play its due part in a theory whose scope and extent we can hardly even guess.

I should not be quite so optimistic about the future of this branch of our science were it not for the fact that a beginning has already been made. Dr. Yates has carried out some investigations on the accuracy of crop estimation by eye in Hertfordshire. Mr. Babington Smith had, before being caught up into the war machine, begun a series of experiments to determine the accuracy of personal judgment of numbers and size. There are, no doubt, other workers who are also studying these subjects from other points of view, though very little seems to have been published on the subject. I hope and expect that we shall live to see the theory of bias in sampling on an equal footing with the theory of randomness.

Now as to the mechanization of statistics. To the ordinary statistician arithmetic is just a nuisance, necessary, but mitigated either by the use of clerical labour or by the use of machines, and almost beneath the notice of the theorist. It is rather a remarkable thing that, great as is the benefit derived from calculating machines by statisticians, those machines were mostly invented

for other than statistical purposes. One could point a moral, I think, from the consideration that Babbage's dream of a difference engine was finally realized by Dr. Comrie in the adaptation of an accounting machine.

There is one other noteworthy feature of these machines, and that is that they all depend on the cog-wheel. For that reason they can add and multiply; but they cannot extract roots or construct powers, except by going through the normal processes of addition and multiplication. The result of this is that a great many statistical processes, such as the calculation of correlation coefficients, are still tedious even on the machine. We must, I think, look for some inventive endeavours by statisticians themselves, if there is to be any further saving in labour. In this connection I may mention the remarkable machine invented by Mr. Mallock for solving linear equations. Mallock's machine abandons the cog-wheel entirely in favour of electrical circuits. Essentially it consists of a number of iron cores, on each of which is a number of independent coils. By exciting magnetic fluxes in the cores and setting up circuits including turns of coils on successive cores, we are able to solve in one operation any set of linear equations of not more than ten variables.

The interesting thing about this machine is that if it is asked to solve a number of equations which is greater than the number of variables concerned, it does its best by providing a least-squares solution. Currents in certain circuits can no longer all vanish, but they set themselves so as to generate the minimum of heat; and since heat varies as the *square* of the current, the sum of the squares of currents (which are proportional to the residuals in a set of linear equations) is a minimum. This principle, it seems to me, offers very considerable possibilities to the statistician. Many of our coefficients may be regarded as least-squares solutions, correlations, regressions, variances and so forth. I can see no reason why there should not be constructed a variance-analyser or a regression-curve fitter on this or some similar principle. There will never be any large commercial demand for such machines, but perhaps as computing becomes more centralized we may expect to see some of these specialist engines come into existence.

And finally, in this brief survey of future theoretical developments, the theory of probability. There has never been anything quite like the controversy over this theory in the history of science. To find a parallel we have to go back to the disputes of the early Christian Church. Statistical historians of the future may find some amusement in embroidering this theme and tracing analogies between the eighteen heresies on consubstantiality and the various views on likelihood, or comparing and contrasting homoousian *versus* homoiousian with confidence intervals *versus* fiducial probability. At the present time we are far from having heard the last word on this subject, but certain broad creeds are crystallizing out. I am inclined to think that in the next ten years we shall see a reconciliation of the several schisms who have in common a frequency conception of probability. Perhaps some post-war œcumenical council will be able to lay down the tenets of an orthodox faith to a congregation worn down by faction to relative docility.

But there will remain the broad division between those who, like most statisticians, maintain that probability in the statistical sense deals only with relative frequencies and those who, like Jeffreys, maintain that a complete theory of probability must include all attitude of doubt, even towards propositions which do not form part of a population. What are we to expect

of this difference of opinion? To judge from past experience, the two sides will never succeed in convincing each other; nor can we expect them to cancel each other out on the Kilkenny cat principle. Unless some strong measures are taken it seems that the contestants will brood and bicker over the drawing of balls from urns until the ashes of science itself are laid to rest in what Sir Thomas Browne called those sad and sepulchral pitchers.

Here again, I think that mathematics and meditation have taken us as far as they can, and that the question is one for experiment. The real point at issue is whether the attitude of doubt taken towards a non-recurring proposition such as "Homer was a woman" is the same as the attitude towards a proposition such as "the sun will rise tomorrow morning". If it is, then Jeffreys is right in maintaining that a complete theory of probability must cover both types of proposition (though perhaps statisticians would be satisfied with the second). If there is some psychological difference, then perhaps the opposing school is correct in maintaining that only the second class can be expressed in numerical probabilities.

This is where an experimental approach to the theory of probability can help us. Is a judgment in probability purely a conscious affair? Do subconscious experiences of a similar proposition influence judgments of the probability of a given proposition? Can a person suffering from amnesia form judgments of the probability of things which he has forgotten? If these questions can be answered we shall at least stand on some ground of solid fact. Nor need we despise the anthropological approach. Do savage tribes have a conception of probability? Are any of their ceremonies regulated by drawing lots? Do they deify chance like the Romans, and if so, under what aspect? I hope psychologists may begin to take an interest in these questions and repay some of the debt they owe to statisticians. Perhaps I am on the wrong lines altogether; but I do feel very strongly that we shall not reach a really satisfactory agreement about the theory of probability until we lift it from the armchair and put it into the laboratory. We may hope to see in the next few years a more Baconian approach to the whole problem.

At this point I leave the future of pure theory. What I have said is perhaps not so much intelligent prophecy as the disconnected vaticination of wishful thinking. But I shall be grateful if any contributors to the discussion feel inclined to offer their own views on the way theory will or ought to develop. There is, after all, no harm in riding our imaginations on a loose rein every now and again. And at any rate in doing so we are not giving information to the enemy, a consideration which nowadays binds most of us to silence on subjects that we know more about.

## THE FUTURE ORGANIZATION OF STATISTICS

### *Statistical instruction*

Whether statistical theory develops on lines we can foresee or not, whether the application of statistical methods extends into domains we can predict or not, there can, I think, be no doubt that both the scope and application of the theory will expand very considerably in future years. We have, then, to enquire whether there now exist the organizations which will be necessitated by this expansion, or whether new organizations will have to be introduced. There will, for example, have to be increased instruction and training in statistics, perhaps in schools, certainly in Universities. At the present time London

is far ahead of the other universities in the opportunities it offers. At Cambridge statistics is not a faculty, and can be studied only as a branch of economics or a branch of mathematics. Since it is neither, the position of the statistical student is rather like that of Kipling's marine, a kind of giddy harumfradite, soldier and sailor too. On the whole I feel that this is regrettable, and that some further recognition of our subject is desirable. However, it is not a matter on which there is much need to dilate. The Universities have on the whole shown themselves capable of adjusting supply to demand, though often by adapting old faculties to new uses rather than creating new faculties, and if we obtain the substance, we can let the shadow look after itself. I will only make the supremely important point that unless we create a sufficient number of academic posts worthy of the many distinguished men who are now engaged in teaching statistics, we cannot complain if the standard of teaching declines and the export of statisticians to the United States continues on an increasing scale.

#### *The possibility of a State Statistical Office*

Apart from questions of training, there arise questions of organizations among statisticians themselves. As to the rôle of our Society in this matter I speak below. The question of international organization is extremely important, but I do not feel I can make any useful comments on it. The other topic which I think we may profitably consider in this connection is the organization of the statistical services of the State. Is there a case for a Bureau of Statistics in this country? The question has been mooted before and, I believe, considered more or less officially, and negatived. But after the war it will be raised again in a new and more poignant form, and I think we can do a very useful service to the Government by giving a considered answer from the Society as a whole. I can do no more on the present occasion than try to start the ball rolling.

Before the war most Government Departments had statistical branches, and one or two even employed statisticians in them.\* The liaison between departments was, however, of the loosest kind, and dependent as much as anything on personal contacts, including those made round the council table of our society. There was an inter-departmental committee of representatives of Government statistical branches, but it never did anything much, and was quite moribund at the outbreak of war. To understand the position it is necessary to remember three things: first, that each Department is responsible for the collection of its own statistical material and is (quite rightly) rather chary of releasing that material in a raw state to other Departments who cannot appreciate the pitfalls and reservations surrounding it; second, that there was very little transfer of personnel from one Department to another, so that one did not acquire a familiarity with a very wide statistical field; third, that under the present system of organization in the Service, the head of a statistical branch is an *administrative* officer—that is to say, a man chosen for his ability to run a branch of any kind, often without any statistical training, and with his only prospect of advancement promotion to some other division where statistics at the most is only an unpleasant ingredient in the daily work. The head of a

\* I am speaking here of the ordinary run of Government Departments, not the very specialized departments such as that of the Government Actuary or the Census Office,

statistical branch was often a man who knew very little about statistics and had had no training in the subject whatever before entering the Service; and what is more, he had as a rule no expert assistance, such as was provided to his colleagues engaged in running other technical branches.

The extraordinary thing is that this system should have worked as well as it did. It has so happened that some departments (and the Board of Trade in particular) have been most undeservedly lucky in finding administrative officers who were just born statisticians. Others, again, managed to run under the momentum imparted by some long-forgotten hand. Others, again, have got along very well because a great deal of the statistics in the Service requires only intelligence and common sense, and the Civil Servant, in spite of the general belief to the contrary, has plenty of both. But as a system it was hopeless.

The war has changed all that. I need not describe a state of affairs which is perfectly familiar to us all—the shortage of trained statisticians, the demand for expert assistance by the Supply Departments and the new Ministries of Food, Information and Economic Warfare, the realization that there do exist men with a peculiar flair for figures who can make sound judgments on the most unpromising material. One feature of the situation, however, is worthy of remark. There is now in existence an off-shoot of the Cabinet Secretariat, known officially, I think, as the Central Statistical Office. Like many other English institutions, it was an improvisation; like many other English institutions, it may outlast the creations of the most solicitous bureaucratic tectonics. But I am not sure that it will do so unless there is some pressure brought to bear from outside the Civil Service. Perhaps Ministers themselves will be so impressed by the usefulness of this body that they will insist on its retention, but we cannot rely on their doing so. The whole issue is so important, not only to the State but to statisticians themselves, that I should prefer to see the Society debate the question very seriously and make some recommendation to the Government.

This sort of organization, be it observed, does not imply the centralization of collection and interpretation of Government statistics in one single body. There is much to be said for leaving the collection of statistics in the hands of people who are in daily touch with sources from which they are derived. What it does provide is a section of the Government which is relatively undisturbed by administrative work and can occupy itself with looking for wood among the trees; and in peace-time it might provide a source of advice on technical matters to those departments which have no statistician of their own or which are not big enough to employ a full statistical branch.

If the Central Office becomes a part of our peace-time Civil Service, the effect on statisticians will be profound. There will be obvious advantages in, such matters as uniformity. The greatest benefit, however, in my opinion, will result from the fact that at last an avenue of promotion will have been opened up for the professional statistician in the Service. Any statistician who enters a Government Department may expect, if he shows any genuine ability, to be called in due course to the Bureau, and any Department which requires statistical aid will have a pool on which to draw. I should find it difficult to exaggerate the effect this would have on the general standard of statistical work carried out by the State.

## THE FUTURE OF THE ROYAL STATISTICAL SOCIETY

This has been what might be called a thin-ice paper. I have been conscious throughout of rushing in where cautious spirits would never venture; and the crowning folly is to attempt to predict or to guide the future course of our Society. However, there are some important things to be said on this subject, and they might as well be said publicly. They all turn on the question: What part are we to play as a Society in the period of post-war reconstruction and the following years?

Let us first of all recognize that concurrently with the growth of statistics our Society is likely to increase in numbers and to have to enlarge its scope. I think we should all agree that, so far as practicable, we should try to cater for all types of statistical interest. Whether we can do so without a certain amount of sectionalization is an interesting point, but I am inclined to doubt it. You will remember that a few years ago the Society formed a Research and Agricultural Section, publishing its own work in a supplement to the *Journal*, to meet the needs of the newer mathematical methods in statistical research. This was in my opinion one of the most politic things the Society ever did, and it has been abundantly justified by the result that, at the beginning of the war, the *Supplement* was beginning to be self-supporting financially. There was also a Study Group which became a sort of Junior School, suitable for younger members who had work to describe and ideas to express, but did not carry the heavy metal necessary to read a paper before the parent body without being blown out of the water by the proposer and seconder of the vote of thanks. During war-time the Study Group is in cold storage. I hope that special efforts will be made after the war to revive it.

But to come to the parent society. At the time of the Society's foundation there seems to have been what looks today like an almost morbid anxiety that it should not become contaminated with politics. The motto of the Society, *Aliis Exterendum*—let someone else thresh our results—was, I think, intended to signify that we should limit ourselves severely to the collection and presentation of data and leave the work of interpreting and acting on them to the feuds and factions, the lobbyings and compromises, of everyday life. It was soon found that this principle was too restrictive and the motto was removed from our crest in 1857, though the wheatsheaf to which it was related has survived to the present day. The feeling behind the motto, however, has also survived to this extent that, in common with other scientific societies, we interpret our results but are careful not to intervene in the activities of the bodies which are responsible for translating general conclusions into legislative action. There is still a feeling that politics is a dirty game and that no scientists ought to get mixed up in it.

I do not propose to discuss whether this is a good thing or not. Nor am I suggesting that we should in any way depart from the precedents laid down by our statistical forefathers. But I do suggest that we might consider how far our Society can set about contributing to the common fund of knowledge on which the authorities responsible for post-war political decisions will have to draw. From time to time in the past we have proffered advice to the Government on important matters with a statistical aspect. For example, on looking through the Society's records I find that we have appointed Committees to consider, among other things, the Census, Official Statistics, Infantile Mortality, Female Migrants, Civil Judicial Statistics and Coal. Apart from the Census Committee of 1931 the last Committee (that on Coal) was appointed in 1925.

Has not the time come for us to resume and extend this practice? Looking to the future, we have no difficulty in foreseeing a dozen subjects on which the Government will require advice and on which we are qualified to give it. The question of a State Statistical Bureau, already referred to, is one. The question of instruction in statistics in schools is another. The question of the preservation of the Statistical Office at Geneva is a third. Then there are various fact-finding matters, such as the economic resources of a federated Europe, on which we are surely qualified to express an authoritative opinion. I will dwell for a few moments on only one subject, a little Utopian, perhaps—that of reform in English weights and measures.

One of the lessons to be learnt from history is that no substantial change is made in human units of measurement without the shedding of vast quantities of human blood. It took the Arab invasions to give us a flexible numerical system and a first-class revolution to generate the metric system of weights and measures. Now, considering that in the present war blood is being let and institutions shattered on a scale unprecedented in history, we may hope that some good may come of it by way of internationalization of standards. I do not have to argue the contention, I hope, that the English system is stupid, illogical, inconvenient, quite incapable of being remembered even by the English, and generally contemptible. Before the war to advocate its abolition was to be classed as a crank; but in the past two years we have seen projects in comparison with which a reform of weights and measures is almost retrogressive. If we can offer federal union to France, can we not adopt her metric system? If we can accept lease-lend assistance on a huge scale from the U.S.A., can we not adopt a decimal currency? I know there are *contra* arguments. Our scales and measuring-rods would have to be changed. People would have to learn to divide by ten instead of twelve and twenty when they buy things. The British workman might have to learn to ask for three *decis* instead of half a pint. And I daresay the British yeoman would bitterly resist surrendering one rod, pole or perch of British ground to the foreign hectare. But I cannot believe that anybody is such a fool as not to appreciate the overwhelming simplicity of the metric system once he has given it a trial. Let us be frank, and agree that the only real obstacle is inertia. Things do not get done in this country unless we are threatened with loss of life, property or support in the House of Commons. I would like to suggest for the Society's consideration that we should throw our full weight on the side of this and other statistical reforms. I do not regard it as satisfactory that we should continue to remain aloof from taking an active and collective part in human progress. The importance of this general issue requires no emphasis. It is perhaps the greatest element in the future of statistics in this country.

It is the custom when reading a paper to the Society either to begin or to end with an apology. My apology comes at the end, and it is this; that I have had to deal in the most cursory way with a number of important topics, each of which deserves a paper to itself. The greatest measure of encouragement I could have is that sufficient interest has been roused to lead to the reading of such papers by authorities who are not open, as I fear I am myself, to the charge of an uncontrolled sciolism, but whose views will carry weight in quarters that matter.

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## DISCUSSION ON MR. KENDALL'S PAPER

DR. SNOW: I will confine myself mainly to that part of the paper dealing with the future of the Society. I feel I can detect in Mr. Kendall's remarks a sense of criticism or disappointment with regard to the recent development of the Society, and am inclined to agree with this view. Considering the very great progress of statistics over the past generation, it may well be contended that the Society has not quite kept pace with the development, in spite of the innovation referred to by Mr. Kendall. I recall that the objects of the Society were formulated in the Bye-laws, 108 years before, in the words:

"The objects of the Royal Statistical Society are to collect, arrange, digest and publish facts illustrating the condition and prospects of society in its material, social and moral relations; these facts being for the most part arranged in tabular form and in accordance with the principles of the numerical method."

The Charter of the Society, which was granted about fifty years later, used practically the same words, but if they had to define their objectives today, they might perhaps be summarized as: "To foster the science and art (or the theory and practice) of the numerical method."

However they actually announced their objectives, what were the various functions which, as a Society, they might do in addition to what they were at present doing? There were a number of possibilities. The Society might become a professional body like the actuaries or the accountants, and provide certificates of statistical knowledge or practice for people to be taken as statisticians into Government Departments or business firms. In view of the very great importance of statistics in many administrative problems, he thought it was well worth debating whether there should not be some competent body to lay down a minimum standard of requirements for those called upon, either in administration or business, to practise the art of the numerical method. Another activity which the Society might follow was that practised by some professional bodies of expressing opinions on the suitability of candidates for appointments where statistical ability was needed. The extension of the Society's functions to cover this sort of activity would probably not find general support, but as the possessors of a Royal Charter giving them the oversight of the "practice of the numerical method" he thought they should take cognizance of the fact that in some appointments nowadays statistical knowledge and skill were desirable, and cases could be instanced where selectors had apparently given no consideration to this side of the subject. A further development which might be undertaken was the setting up of *ad hoc* committees to report upon specific subjects having a statistical aspect. For instance, before the war of 1914-18 the Society considerably assisted the work of the Dominions Royal Commission in its statistical aspects. In recent years there has been the Drage Committee, and activity in connection with the proposal for a quinquennial census in 1936. I recall that the Society wrote a letter to *The Times*, advocating such a census, which proposal, however, was rejected on the ground of expense. The results of such a census, however, would have been of great benefit in many of the grave problems which had to be considered in 1939.

A further development might be in the direction of more sections. Possibly it might become desirable to separate the Industrial and Agricultural Section into two, and these might ultimately sub-divide further as the subject became more and more specialized. I think I have a duty, as the Senior Honorary Secretary, to make a specific proposal to the Council for the question raised by Mr. Kendall to be formally considered, and I hope to do so in due course, but the great period of reconstruction in national affairs which is coming would be an appropriate time to consider whether any fundamental changes in the Society's scope were needed.

I have no time left to speak at length on any other part of the paper, but



I want to refer to one paragraph concerning the function of the statistician in the Civil Service. Mr. Kendall appears to hold the view that the statistician's prospects in the Civil Service should be *qua* statistician only, and that, while he should still remain a statistician, there should be far more hope of reward for him than he has at present. I take a different view. I consider that the training of the statistician makes the latter a far better administrator than one without statistical training. I would draw a proportion of administrators from the statisticians. My experience in the present war has convinced me of the frequent weakness in administration by people who have only a superficial knowledge of the subject-matters on which they administer. Knowledge of the subject-matter is fundamental for administration, and particularly for that type of administration where prompt decisions are needed, and this knowledge is obtained by first being the statistician on the job.

In conclusion, I have great pleasure in proposing the cordial thanks of the Society to Mr. Kendall for his paper, which has undoubtedly given us food for thought for a long time to come.

MR. H. CAMPION, in seconding the vote of thanks, said: I agree with a great deal that Mr. Kendall has to say; on some points I should be interested to know more of the reasons for his statements. In particular, I should like to hear more of the case he has for recommending teaching statistics in schools. Mr. Kendall, however, has given a very stimulating paper, which should be taken seriously, and I should like to discuss one or two of the points which he has raised.

As he says, rapid strides have been made in the last ten years in the development of statistical methods and the extension of the use of these methods in different fields of enquiry. This has had two effects: (i) it has become increasingly difficult for people to keep abreast of all new developments in statistical methods and their use, especially when they take place outside their own field of work; and (ii) those engaged in statistical enquiries have probably less in common than they had before, since it is essential for anyone working with statistics in any field to spend almost as much time in watching developments in his field of work as on statistical methods. For example, anyone at present working on economic statistics in this country must be in touch with recent developments in economic theory.

The danger which Mr. Kendall has in mind is that the field of work in statistical methods is becoming so wide and diverse that there is a strong case for establishing a status for a limited number of statisticians proper in each field of work, whether in economics, biology, or physiology. I think, too, that if his proposal for strengthening the Government statistical service were accepted, it is essential to improve the status of the statisticians in industry also, so that there may be outside the Civil Service a strong independent body of professional statisticians.

With regard to the teaching of statistics in universities, people going into industry and administration find a knowledge of statistics is becoming a prerequisite for an effective entry. On the other hand, people wishing to take up academic careers as economists or wishing to enter the Civil Service are not obliged to acquire at the universities a working knowledge of statistical methods. The number of posts as statisticians open in the universities is still too few. A person wishing to enter the Civil Service who, from his academic record, is potentially good in that particular field, cannot be guaranteed a post in a statistical department when he enters the Service. Practical statistical training, moreover, does require some post-graduate studies for at least one or two years, and a person entering the administrative Civil Service cannot undertake this, as he must usually concentrate on his entrance examinations to the Civil Service.

All this has an effect on the future of the Society, of which, as a new member of the Council, I must speak very humbly. Now that people doing statistical work are becoming more scattered and more specialized, it is essential that

they should keep in touch with one another, and the Society has a real function in bringing together members not only in the Civil Service and academic posts, but also in industry and trade. Presumably all those who enter the Royal Statistical Society do so because they are interested in their subject, and it is probably true that there has not been sufficient opportunity for them to meet and discuss each other's problems. A meeting such as this is not sufficient to afford the opportunity for the more informal discussions necessary to stimulate the work of statisticians.

This leads me to one further point, and that is one with which I am especially concerned. One of the urgent problems at the end of this war will be to provide real opportunities for the many young and able statisticians and economists who have come to the front since the war and are now engaged on Government work. If their services can be properly used, I think we need not fear very much, at least about the future of economic statistics in this country. I hope this Society will provide a common meeting-ground for them.

THE CHAIRMAN put the vote of thanks to the meeting, and it was accorded unanimously.

DR. ISSERLIS said that he had aided, although not abetted, Mr. Kendall in presenting this paper to the Society, and it must be taken as being self-evident that he cordially supported the vote of thanks which had been proposed, seconded and carried.

A contribution had been received from Mr. Yule, which he proposed to read, but would first offer a brief comment of his own. On p. 73 Mr. Kendall said that the difficulty that had long tormented the statistical logician could, he thought, be met. His words were: "Questions of the type: does the mean of the population lie between two given numbers are replaced by the type: does it lie between certain values of the sample such as the quartiles, whatever they turn out to be?"

The speaker suggested that Mr. Kendall might reconsider that. It seemed to him that the two things were equivalent.

Dr. Isserlis then read Mr. Yule's contribution:—

MR. G. U. YULE: When a writer says, "There can, I think, be no dispute" about any proposition, the inevitable reaction of a normal sinful man is at once to show him that his thought is mistaken. I propose accordingly to traverse Mr. Kendall's proposition that "the estimation of properties of a population from a sample is the most important practical problem in statistics and is long likely to continue so." It never was, in *my* opinion, the most important practical problem in statistics, and so cannot continue to be that which it never was. I put aside the point that the most important practical problem for the statistician is really *how to get his sample*, for the sample is evidently assumed to have been obtained. The *initial* problem of the statistician, or of statistical method, if we like to personify it, is then simply the description of the data presented; to tell us what the data *themselves* show. To this initial problem the function of sampling theory is in general entirely *secondary* or ancillary; to inform the investigator as to the limits within which his descriptive measures can be trusted, so far as fluctuations of simple sampling alone are concerned. The development of theory during my own lifetime followed at first the natural course suggested by this fact. Primarily it was new *methods* that were developed, and investigations of the "probable errors" involved only followed in their train. More recently methods, with few exceptions (time-series in economics, factor-methods in psychology), have been almost neglected, while there has been a completely lopsided development—almost a malignant growth—of sampling theory. I hope there may be a swing back towards the study of method proper, and as methods only develop in connection with practical problems, that means a swing back to more practical work and less pure theory. The comparatively recent development of the

purely mathematical statistician, with no knowledge and apparently no taste for any line of practical work (to whom the overgrowth of sampling theory may perhaps be partly ascribed), is itself not a healthy feature.

There are quite large fields of statistics into the discussion of which sampling theory hardly enters at all—*e.g.*, statistics of trade and production. Nor do we feel any need for it in handling the simpler figures of vital statistics, the death-rates, birth-rates, etc., for the country as a whole. Not only is the basis of the figures too large for fluctuations of sampling to be of importance, but there is obvious difficulty in regarding them as figures for a sample. The death-rate for England and Wales, 1901, say, is (within the limits of error of counting not of sampling) what it purports to be: in what sense can the population of the country in 1901 be regarded as a sample? a sample from what universe? Even in the field of experimental work, if the investigator possesses caution, common sense and patience, those qualities are quite likely to keep him more free from error in his conclusions than the man of little caution and common sense who guides himself by a mechanical application of sampling rules. He will be more likely to remember that there are sources of error more important than fluctuations of sampling (*e.g.*, bias). If he has a very small sample, his caution will lead him to put it aside altogether until he can get additional evidence, rather than draw any rash conclusion, and, being patient, he will be willing to wait. No: I cannot assign the place of highest importance to sampling theory—a high place perhaps, but not the highest.

DR. WISHART said the paper lent itself better to suggesting subjects for future papers rather than to discussion within that evening's time limits.

As a nation we were fairly good at scientific investigation, but not nearly so good in the organization of science. War problems were not yet rightly focused as problems of scientific method. He considered the Services weak in tackling their problems scientifically or in making the best use of their limited scientific personnel, thus showing how far we were from a national consciousness of the scope of science. There were statistical branches in some departments, but many were only counting machines. Much had been said of the place of mathematics in the theory of statistics, but how many mathematical statisticians were either not employed in the war effort or used only as administrators?

He himself preferred to concentrate more on the present than the future, partly to dispel any impression that the Society in war-time engaged only in philosophical speculation, and partly because the study of their subject was justified only so far as it could be applied to the solution of practical problems. The way in which statistics *as a science* could stand up to the strain of war conditions was a measure of its maturity or otherwise *as a science* for consolidation after the war.

He could not see any coherent structure in the organization of statistics before the war—mathematicians, economists and business statisticians had little use for one another, and none of them made things easier for the man in the street. The Society had split into its Main and Section Meetings and Study Group. He would not care to be dogmatic as to the future, but appealed for a greater measure of mutual understanding. It would be most necessary to give close attention after the war to the organization of statistical instruction. Few universities gave serious attention to the study of statistics. At Oxford little was done. At London no one had been found to fill the Chair in Statistics vacated by a distinguished Fellow and former President of the Society. The developments at University College under Karl Pearson were well known. Yet since his retirement, although teaching and research had developed, there was lack of harmony between the eugenic and biometrical sides. At Cambridge the growth would attain fruition only with the establishment of a statistical faculty. It was possible, however, for the mathematician to get practical instruction in statistics, including the use of calculating machines, and to apply his post-graduate research to practical problems in

biology, particularly experimentation; for the biologist with some flair for mathematics to study the principles underlying statistical processes; for the mathematician to become an economist; and for the economist with mathematical training to study the theory of statistics. More should be done in extending such teaching to the provincial universities.

MR. BABINGTON SMITH said that in his extremely interesting survey there were two points where Mr. Kendall had referred to what was common ground between statistics and experimental psychology. The first was the theory of bias. The question usually asked in this connection was why human judgments differed from those given by some standardized instrument. Reference had been made in the paper to the estimation of crops, which could be later checked by measurements of weight or volume; and in the field of experimental psychology much work had been done on "optical illusions." To a great extent the issue had been obscured by the way in which the question had been asked. Attention had been drawn all the time to cases where human judgments differed from so-called objective measures. As soon as one was dealing with measurements of quality there was much less cause for speaking of errors of judgment, and it seemed to him that one should not be concerned so much with errors of judgment, *i.e.*, bias, but should rather attempt to find out what happened—what were the factors leading to the final judgment. In other words, it was more a matter for a theory of multiple factors than for a theory of bias.

The second point was the theory of probability. It was very hard to come to this enquiry with an open mind. Owing to the efforts of gamblers and mathematicians, nearly all organized thought on the subject was based on the frequency theory or aware of it, and so infected by the virus. In this, as in the former instance, it might be that reframing the question would lead to progress. In any case, to make an experimental enquiry in order to settle the issue between two rival theories would simply lead to trouble.

MR. EPPS said it would be interesting to know what bitter experience led Mr. Kendall to the conclusion—which did not accord with the speaker's experience—that Government departments had yet to be convinced that statistical sampling would help in the solution of their problems. That idea had surely been exploded at least twenty years earlier. Reference might be made to the impressive series of reports issued by the Ministry of Labour from 1924 onwards analysing the results of large and small samples of the population covered by the Unemployment Insurance Acts, and there were also similar investigations made by the Government Actuary in regard to National Health Insurance.

Mr. Kendall entered upon a very interesting field in the later section of his paper, dealing with official Government statistics. This issue was a live question, as he said, immediately after the last war, when a Cabinet Committee was appointed to enquire into the defects alleged in the Petition to His Majesty's Government of 1919. It might well be that it would be right for further consideration to be given to this in the period of reconstruction after the present war, but he thought it was wise to sound a note of caution with regard to some of Mr. Kendall's remarks in this section.

As to the course of events in the period between the two wars, it was sufficient to point out that the traditional British policy of each Government department being responsible for the collection and interpretation of its own statistics was in no way departed from, and the machinery of the Permanent Consultative Council on Official Statistics was, as indicated by its title, designed for consultation and co-ordination, but it had no executive functions, and did not form the nucleus of a Central Statistical Bureau.

Little had been said officially about the Central Statistical Office set up by the Prime Minister last year, and the only reference appeared to be in the Budget Speech of 1941. In referring to the White Paper on national income and

expenditure, the Chancellor said: "These tables are the very valuable first fruits of our new Statistical Office set up by the Prime Minister, and which now assembles for the information of the War Cabinet and Government departments regular series of statistics more conclusive than those which we have hitherto possessed." From that it was not difficult to infer that the main object of the Office was co-ordination in the presentation of statistics compiled by the many Government departments concerned for the information of the War Cabinet and its committees, but these appeared to be limited functions related to war-time requirements, and it would be a mistake to consider that this organization was the nucleus of a Central Bureau as envisaged in the discussions of the past.

MR. R. G. FORRESTER said that he was extremely interested in the remark made that the Society had largely failed to take account of the fact that there was a war on. The British Association and the Association of Scientific Workers had quite recently held conferences on the war effort, but in neither of these did any statistician participate. This was rather unfortunate in the present circumstances, for the war and the increased Government planning on a large scale had set up a need for statisticians. The approach to the problems of planning had been purely pragmatical. He felt that the Society would be doing something very useful if it could collect some information on planning methods of the kind which must have been available in the Soviet Union as a result of their years of experience of planning by the Central Planning Commission. The Central Statistical Office of the War Cabinet did not fulfil that function. It was purely a body for collating information supplied by other departments and putting it forth with relevant detail to the Prime Minister and his Cabinet. But that was not in itself enough. The Commission must be a group of people able to suggest what was the best line of advance. Too much was made of the argument that nothing could be done in war-time. The only test should be that if a thing was going to be useful for winning the war, it should be set up now. The Study Group of the Society might be usefully resuscitated. There were many young statisticians who would welcome the opportunity of discussing the problems of the application of statistics to the problems of Government.

Before the war there was a small circle of private statistical people who met together to examine the trend of business necessary for them in their forecast of future developments, and to consider new techniques in the application of statistics to business problems, and in that respect much useful work was done. He, therefore, thought it would be useful to establish an Industrial Section of the Society, not, however, cut off from the main body, because it was equally important that there should be discussion of the more general principles of statistics as well as those specially affecting the problems of industry.

If anybody in this connection breathed the word "crank," he would remind them of a useful definition of "crank" which applied both to men and machines - little thing that made revolutions.

THE CHAIRMAN (Professor Major Greenwood) said that he took the privilege of an elder to point out certain little difficulties in the path of official statistics. He would mention two of them. The first was suggested by an incident which took place two or three weeks ago, when a young gentleman came to see him and told him he was engaged in research in the Operations Branch of the R.A.F. He remarked that he had seen a reference in an American journal to a paper by Mr. Udny Yule and himself on the statistics of accidents, published in the *Journal* of the Society in 1920, and he wanted to consult it because he thought it might have some bearing on research work in his branch. The speaker asked his interviewer whether he realized that since 1920 there had been many papers on the subject of accidents and accident-proneness, that there were several highly expert persons in the Air Ministry engaged on this

subject, and whether he thought that a novice—he had told him that mathematics was not his strongest point—was very likely to do as well as experts in a difficult study. The interviewer, who had a rich vein of unconscious humour, replied with regard to the first point that nothing was known of these papers in the Operations Branch, and with regard to the others, that the work, being of a highly secret character, could not be discussed with persons not in the branch.

Those who were inclined to throw bricks at that young man could only do so after they had put their hands on their hearts and said, "We have never felt a secret thrill of satisfaction at believing ourselves possessed of secret information," and also after they had affirmed that they had never attempted to solve a problem which they were perfectly well aware that some more expert person could solve, in the hope of being able to "wipe the expert's eye." Collaboration and the pooling of information were very easy things to talk about, but not very easy things to accomplish, and it might be found that secrecy and the team spirit would be much more formidable obstacles to overcome than perhaps the present author imagined.

The second point was merely this, that it was a little difficult to say exactly what a statistician was. The word had no legal connotation. The great advantage of a legal connotation was that it reduced the area of jobbery. If, for example, a Government post must be filled by a barrister, it reduced the field within which personal influence could be exercised. So far as he could judge with regard to appointments to statistical posts during this war, the existence of the Central Register, over which some of them had spent a good deal of pains, had made little difference in methods of selection.

Dr. Snow was on very sound lines in suggesting that the time might come, not for the Society to be turned into a purely professional organization, but for the drawing up of some kind of prescription—should he call it?—as to the qualifications, whether ascertained by examination or resulting from experience, to be held by persons who were to be regarded as eligible for specifically statistical appointments. But that again was a question for separate discussion.

It was clear from what had been said that the paper had aroused widespread interest, and the author would accept their hearty thanks. If he chose, instead of replying orally, he would have space to write his reply even in the present restricted Journal.

The following contributions were received in writing:

PROFESSOR E. S. PEARSON: Those of us to whom the war has brought new work, new contacts and a break with old traditions and outlook are conscious, in spite of all that war means, of a thankfulness for this new experience; we do not want to, indeed we could not, take up our work again at the same point and in the same way as we dropped it. Yet we have not perhaps had the time nor the imagination to visualize what our new world should be. Coming at this moment, we hope towards the end of the years between, Mr. Kendall's paper has given to one reader at any rate just the kind of stimulus that was needed.

Several of Mr. Kendall's suggestions for future investigations concern that vital link in the chain of statistical inference, the relation of the conceptual model of mathematical theory to the data of experience. Consider one aspect of this. He has referred to past controversies over the theory of probability, and has suggested that it is the experimental approach alone, and not mathematics and meditation, which can now take us any further. This idea suggests at once the following direct questions for mathematical statisticians: how far do we practise what we preach in journal contributions, classroom or meeting-hall? Exactly how important a part do numerical probability measures play in the practical decisions following from our analysis of statistical data? Is our confidence in probability theory related to the simplicity of the technique used? How often are we completely satisfied that the assumptions of randomness and so on have been met?

Frankly, for my part I do not know the answers, and I see no way of obtaining them except by attempting to keep a brief case-history of every problem with which I am concerned in which a numerical probability measure is calculated to guide a practical decision. It may be difficult to keep such records in an unbiased way, and the self-consciousness rendered in the process might even modify normal reaction; but if a fair record could be taken, it seems to me possible that the pooled data so collected by a number of co-operating statisticians would provide invaluable experimental material throwing light on the problems in judgment and probability, which will never be settled by argument.

Mr. Kendall's experience has been concerned with convincing Government departments that samples may be used to represent populations; it has been part of my job to convince them that inadequately small samples should not be treated as populations. But whatever our field, we are agreed that post-war weeds must not be allowed to smother our war-time digging. If the Society as a whole can play a part here, it will be a great achievement.

Finally, I should like to make one correction to what Mr. Kendall has said. He speaks of the confidence interval theory as the joint work of Professor Neyman and myself, but this is not quite fair to the former. Jointly, Neyman and I were concerned with the methods of choice of the most efficient test of a statistical hypothesis, and we laid down certain principles and procedures which may be summarized in the phrase: choose your test so that in the long run of experience the risk of drawing wrong conclusions is reduced to a minimum. The extension of these ideas to the problem of estimation was Neyman's, and the inner history of our collaboration would, I am afraid, show that it was my slowness of mind in grasping the new conception which discouraged him in 1929-30 from developing his ideas fully in print. But for this, Neyman's first paper on the theory of confidence intervals would have appeared before 1934, and the distinction in origin of this theory from R. A. Fisher's fiducial theory would probably have been clearer at an early date.

MR. R. F. GEORGE: Much to my regret, I was unable to be present when Mr. Kendall read his stimulating paper, and I should therefore like to offer a written contribution, particularly with reference to the section on the future organization of statistics.

It is surely a most hopeful portent that the Treasury has recently arranged for the London School of Economics to give short intensive courses of instruction in elementary statistical methods to junior Civil Servants. Two such courses have so far been undertaken, the pupil population having been drawn largely but not exclusively from the temporary Departments. The results, so far as they have come to my personal knowledge, have fully justified this innovation. One has to remember, however, the official view that a clerk is equally efficient in any clerical capacity, and that a statistical Branch has no special claim on people with statistical inclinations.

The view seems generally accepted that State control of the economic and social life of the country after the war must be exercised to a greater extent than ever before. I suggest that this likelihood adds to the existing arguments for a State Statistical Office. The issues associated with economic control are not, and cannot be, exclusive to any one Department, nor, therefore, statistically served by any one Branch within a given Department. If, for example, the subject is the regional distribution of industry, such questions as population, housing, production, possibly agriculture, and certainly distribution are at any rate bound to come under review, calling for statistics from several Departments. In such a case, the benefit of a State Statistical Office is obvious. There must be many similar examples of questions of major policy involving the work of several Departments simultaneously, and which would accordingly justify a State Statistical Office.

Lastly, the State in the immediate future must be more and more occupied with the social conditions of the people, and the first essential condition of

any effort whatever in this direction must be a knowledge of social conditions as they are. This knowledge is very largely given by the various Social Surveys which have been conducted during the last 20 years, of which Mr. Rowntree's recent volume on York is the latest. It is a common feature of all these investigations that they have been undertaken either by private enterprise or under the aegis of a university; in no case, as far as I know, has a social enquiry been undertaken under the control of, or at the request of, or certainly at the expense of, the State. The data provided by these enquiries are invaluable, and I make a strong plea that these relatively expensive investigations should be given the direct and warm support of the Government. It may not be advisable for them to be directly conducted and the general work to be immediately controlled by the State. But it surely is desirable that a larger measure of co-operation should be officially given, and that these enquiries should not be left entirely to the initiative of private individuals, or the cost of them to quasi-private benefactions and institutions.

MR. H. W. G. GEARING: With reference to Mr. Kendall's suggestions regarding the overhaul of the methods of teaching the subject, I feel that in the future more reference should be made to (a) the various mechanical aids to analysis, such as the mechanical and electrical punched card machines and the principles of their operation; and (b) in the Faculty of Economics, to the principles of accountancy underlying the profit and loss or revenue account and balance sheet, which teaching is not at present included in the B.Sc.(Econ.) course, though it is included in the Commerce degree.

In the midst of so much reorganization it is good that Mr. Kendall should suggest that Fellows consider positively the future of the Society. Should it, for example, become an examining body like other professional societies, or should it seek further strength through amalgamation? Could it not more easily set up connections in the provincial towns while so many of its members are evacuees for the duration?

If we could obtain the co-operation of such bodies as the Management Research Groups and the Accountancy and Insurance Professional Associations, there would surely be an overwhelming body of opinion to initiate decimal reforms and accelerate every commercial computation beyond the pages of the Ready Reckoner, which most surviving businesses have outgrown.

MR. KENDALL said that, in view of the lateness of the hour, he would defer his reply to the Journal. He subsequently wrote as follows:—

I am grateful to the various contributors to the discussion for the ideas they have put forward. There were fewer points of criticism than I had expected.

Dr. Snow's suggestion that there ought to be some professional qualifications for statisticians strikes me as extremely important and I hope that the Society will consider this matter. Professor Greenwood refers to the problem of defining a "statistician," and from personal experience I can support him and Dr. Snow in stressing the difficulties of a business man or an Establishment Officer in the Civil Service who requires a statistician but has no accepted qualifications whatever on which to work. Since statistics is fast becoming an accepted profession, there is a great deal to be said for instituting professional qualifications. I am not so sure that it would be the function of our Society, as such, to provide them, but the means would not be difficult to decide upon once the end had been agreed.

Members of the Society will note with satisfaction that Dr. Snow proposes to raise with the Council the question of sectionalization of the Society and particularly the separation of the Industrial and Agricultural Research Section into two. I hope that he will not postpone the tabling of this matter too long.

As to the prospects of the Statistician in the Civil Service, I agree fully with what Dr. Snow says as to the desirability of an administrator having statistical training and also with his comments as to the possibility of finding expert administrators among statisticians. We have, however, to recognize that there



are a number of statisticians who are not outstandingly gifted in administration, and it is such men who have very little prospect of advancement in the Service. Moreover, a statistician in a Government Department does not always have an opportunity of showing his administrative talent. The question is really bound up with the relationship between technical and administrative grades in the Service, a matter which itself may have to be looked into very carefully at the end of the war.

The only point in Mr. Campion's contribution calling for my comment is his enquiry about the case for recommending the teaching of statistics in schools. It seems to me that after the war the movement towards the extension of the school-leaving age will be very strong and may push the leaving age up to 18. In any case, the education of adolescents is a very different problem from that of the education of children and it seems to me that the post-war educational problem will be not so much one of extending the present system of education as of finding of new methods and a new curriculum altogether for adolescents. For example, I should expect an adequate amount of attention to be given to training in social science, and it is here that I think statistics would naturally enter into the curriculum. I have not space to develop this point any further, but it will be evident that I am thinking of the training in economic and social statistics rather than in statistical method, which is a specialized matter and might be linked up with mathematics. How far statistical theory should be taught in schools I am undecided; but since the object of lower school education should be the teaching of the technique of learning rather than the instilling of actual knowledge, there is something to be said for Mr. Gearing's suggestions about mechanical computation.

I am sorry to differ from Dr. Isserlis, but I still think that my original comment on the theory of confidence intervals was a sound one and that in fact it exhibits the crucial distinction between the newer approach and the older approach. There seems to me to be a very great difference between talking of probabilities in relation to fixed numbers selected beforehand and variate values, which are not known until the sample is taken and which vary from sample to sample. I derive support from the fact that Professor Pearson has not in his written contribution demurred from my interpretation.

There is less difference between Mr. Yule and myself than might appear. The important position I gave to the theory of sampling arose from the consideration that nearly all the data we have are samples from some population or other. Mr. Yule would differ from this, I gather, mainly because we do not quite see eye to eye on the question of populations. To take his example, the population of human beings in England and Wales in 1901 is from some points of view not a sample and no question of sampling variability of the death-rate in that year would arise. If, however, we are to consider death-rates as a whole, the main use of such figures is in comparison between one year and another or between one country and another. In short, the isolated figures for any year are studied mainly as members of a population of such figures. However, I would agree with Mr. Yule (and in fact I would not dare to differ from him on such a matter) that, for practical purposes, a great deal of the modern developments of the theory of sampling has taken place at the expense of other and more important practical work. Perhaps we *have* let mathematics run away with us a little. It is interesting to see from Professor Pearson's remarks that he may feel something of the same kind when he suggests that we should keep running records of the cases in which we make inferences from data and note how often we really rely solely upon the theory of probability and not intuitive judgments. This is an intriguing suggestion which I hope he will develop.

Mr. Epps enquired for the actual basis on which I founded the statement that Government Departments were not kindly disposed towards sampling. This puts me in a rather difficult position, because I did not want to discuss particular cases. Perhaps he will accept my assurance that such cases have come to my notice; and in fact I was rather surprised to be challenged on the point at all. In a footnote to the paper I pointed out that I was not speaking of

specialized Departments, such as that of the Government Actuary, and I know that sampling enquiry has been undertaken both by the Government Actuary and by the Ministry of Labour. My general feeling, however, is that Government Departments in the past did not undertake sampling enquiries unless they were forced to it by the sheer magnitude of the population to be considered. One cannot help making comparisons in this respect with the attitude of the United States. For example, I have seen reports that the U.S.A. intend to take a census during war-time on a sampling basis. I wonder whether a similar proposal was considered in regard to the deferred census of 1941 and, if so, what the official attitude towards it was.

Much as I sympathize with Mr. Forrester's suggestion about the revival of the Study Group in war-time, I must point out that the members of the Group themselves found it necessary to suspend its activities during the war as they had no time to give to the work. However, this is not a matter for me to decide and no doubt the Society have noted the observations on the subject.

Perhaps the other participants in the discussion will forgive me if I do not deal with their points in detail. There is too much to be said on many of these matters for an adequate treatment in the space at my disposal. It is, however, very gratifying to see that so many topics are being considered in relation to our science and the whole augurs well for the future vitality of the Society.

As a result of the ballot taken during the Meeting, the candidates named below were elected Fellows of the Society :—

John Henry Kirk.  
Arthur Seldon.  
Leonard Charles Worrall.

*Corporate representatives*

F. A. Burchardt, *representing* The Oxford Institute of Statistics.  
Thomas Rayner Dawson, *representing* the Research Association of British Rubber Manufacturers.  
Helen Grace Liddell, *representing* the Royal Institute of International Affairs.

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## THE SIGNIFICANCE OF FISCAL STATISTICS

By G. L. SCHWARTZ

[Read before the ROYAL STATISTICAL SOCIETY, May 19th, 1942, the PRESIDENT, SIR WILLIAM BEVERIDGE, K.C.B., LL.D., F.B.A., in the Chair.]

IN the realm of social data fiscal statistics vie with vital statistics and the returns for foreign trade in respect of longevity and prolificness; in respect of their baleful associations in the popular and even the informed mind they stand in a class by themselves. It would be a very unsophisticated cross-word which set the clue: . . . . . of taxation: the answer could only be one word of six letters, **BURDEN**. And associated with the noun is a plethora of adjectives—oppressive, intolerable, crushing, ruinous—indeed, all the negative correlatives to the concepts of wealth, ease, pleasurable and goodness to be found in the parallel column of the thesaurus. The growth of State expenditure has been generally described as menacing, even before the days when Bright moved that £70 mn. should be the absolute limit. The forecast of a £100 mn. Budget was an “unduly pessimistic” prophecy of Randolph Churchill, and his son had occasion later to warn the country that a £200 mn. Budget “loomed portentous”! A decade ago £1,000 mn. was the conventional bogey line, but now the lid has blown off and the sky is the limit. Curiously enough, a £4,500 mn. Budget has apparently killed the bogey, at least in political circles, since the distinguished dean who on the best authority of the nineteenth century gloomily interpreted this as the equivalent of “bleeding to death” brought upon himself the stern rebukes of the Chancellor and a succession of M.P.’s.\* He may have expected his views on finance to be denounced as narrow, but he must have been startled to see them labelled old-fashioned, which in this context can hardly mean more than pre-1939, if as far back as that. Taxes, said John Bright, mean bareness of furniture, of clothing and of the table in many a cottage in Lancashire, in Suffolk and in Dorsetshire. They mean an absence of medical attendance for a sick wife, an absence of the school pence of three or four little children—hopeless toil to the father of a family, a cheerless old age, and, if I may quote the language of a poet of humble life, at last—‘the little bell tolled hastily for the pauper’s funeral’. If the date of this, 1855, marks it as old-fashioned, the passage can be paralleled by a quotation from a current authoritative work on Public Finance written by an ex-Minister:

“All the financial operations of the State are an unmitigated evil, which is, unluckily necessary. It is an evil, though a necessary one; that the State should have to collect and spend a revenue. Could we do without taxes altogether we should all be better off.”†

A contemporary economist of international repute has expressed the same views:

“Liberal taxation proposals must necessarily be misunderstood unless it is realized that liberal politicians look on every tax as an evil—though up

\* See the report of the House of Commons debate, October 1st, 1941.

† Lord Kennet, *System of National Finance*,

to a point an unavoidable one—and that they proceed from the assumption that one must try to keep State expenditure down to a minimum.” \*

If any principles of public finance have emerged from these doctrines, they come to little more than a resigned acceptance of the evil and the practical counsel that taxes, like Mrs. Gamp's porter, should “come reg'lar and be draw'd mild.”

It is not surprising, therefore, that the main use of fiscal statistics hitherto has been as a measure of the burdens imposed both on the collectivity of citizens, and on the individuals comprising that collectivity. Periodically the Financial Secretary to the Treasury gives a written answer which is duly reported in the Press in terms of melancholy pride:

“*Britain Pays Most*

“John Bull, with a taxation per head for 1933–34 of £14 10s. 6d., heads a list comparing tax burdens in various countries contained in a parliamentary answer. France comes second with 1,105·81 francs for 1934 (£13 3s. 3d. at 84 francs to the £), Germany third with 105·99 R.marks for 1933–34 (£7 14s. 7d. at 13·70 R.marks to the £) and U.S. fourth with 18·47 dollars (£3 12s. 5d. at 5·10 dollars to the £).”

It can safely be said that as far as the comparative nature of these statistics is concerned, the figures are inaccurate and the interpretation meaningless. With their meticulous calculation to the nearest penny and the second decimal place, they are an appalling example of useless inductive labour. It is a hopeless task to attempt to put the finances of unitary and federal States on a comparative basis, and even in the case of unitary States, the fiscal structures differ so greatly that comparative figures are almost impossible of computation. It is astonishing, however, to what uses such statistics can be and are applied. All taxation, it is held axiomatic, is a tax on industry, and doubtless the above figures would be regarded by many as an exact measure of the handicap under which British industry laboured in the world markets at that date. Deducing from the figures that the tax burden here was about 10 per cent. higher than in France, 100 per cent. higher than in Germany and 300 per cent. higher than in the U.S., they would regard tariffs of similar percentages on the imports from the respective countries as necessary to equalize the burdens, and claim that this constituted a scientific tariff.

But there is no need to emphasize the dubieties of international tax comparisons. It is sufficient to analyse the figures for our own country to ascertain whether any accurate measure of the burden can be made, and whether any figure so obtained has any significance. In the case of the U.K. the figure of £14 10s. 6d. quoted above was presumably derived from the National Revenue Account, which in the year in question took the form shown on p. 94.

According to this table the amount of taxation levied was £652 mn. Divided by roughly 45 mn., this gives the estimate of £14 10s. 6d. per head of population.

It will be noted that there is a threefold major classification in the Account which distinguishes tax revenue from non-tax revenue, and, in addition, segregates two items of a self-balancing character. This form of classification is in itself a reflection of the general prejudice against large budget totals. Since popular attention fastens on grand totals and no Chancellor was anxious to reach a new high bogey mark, sub-grand totals were inserted in order to give what

\* L. von Mises, *Socialism: An Economic and Sociological Analysis*.

TABLE A  
*United Kingdom*  
*National Revenue*

										Estimates 1933-34	
										£Mn.	
<i>Ordinary Revenue :</i>											
<i>Inland Revenue :</i>											
Income Tax	...	...	...	...	...	...	...	...	...	228.7	
Sur-Tax	...	...	...	...	...	...	...	...	...	51.0	
Estate Duties	...	...	...	...	...	...	...	...	...	74.8	
Stamps	...	...	...	...	...	...	...	...	...	20.4	
Excess Profits Duty and Corporation Profits Tax	...	...	...	...	...	...	...	...	...	2.2	
Land Tax, Mineral Rights Duty	...	...	...	...	...	...	...	...	...	0.8	
										377.9	377.9
<i>Customs and Excise :</i>											
Customs	...	...	...	...	...	...	...	...	...	168.0	
Excise	...	...	...	...	...	...	...	...	...	101.2	
										269.1	269.1
<i>Motor Vehicle Duty :</i>											
Exchequer Share	...	...	...	...	...	...	...	...	...	5.0	5.0
Total Receipts from Taxes	...	...	...	...	...	...	...	...	...	652.0	
Post Office (Net Receipts)	...	...	...	...	...	...	...	...	...	11.7	
Crown Lands	...	...	...	...	...	...	...	...	...	1.2	
Receipts from Sundry Loans	...	...	...	...	...	...	...	...	...	3.8	
Miscellaneous	...	...	...	...	...	...	...	...	...	30.8	
TOTAL ORDINARY REVENUE	...	...	...	...	...	...	...	...	...	698.7	
<i>Self-balancing Revenue :</i>											
Post Office	...	...	...	...	...	...	...	...	...	59.4	
Road Fund	...	...	...	...	...	...	...	...	...	24.1	
										83.5	83.5
TOTAL REVENUE	...	...	...	...	...	...	...	...	...	£782.2	

was held to be a truer picture of the situation. For this reason the Post Office item was segregated from the main account in 1928-9, on the justifiable argument that an increase in this item did not represent a further levy on the citizen *qua* taxpayer, but a voluntary payment by the citizen *qua* consumer for increased use of postal services. On the same reasoning the Road Fund was segregated as a self-balancing item, since the State was supposed to be furnishing equivalent road services to the motorist. (The analogy with postal services is dubious, but it can be accepted for the moment.) It was agreed that if the Exchequer appropriated any part of the Road Fund, that part should be regarded as a levy, and consequently we find the Exchequer share of the Motor Vehicle duty placed above the tax line. But if this surplus is regarded as a tax, why is not the surplus on the Post Office similarly classified as a tax, and the item placed above the tax line? The surplus which is now being derived by the war-time increase in postal rates is obviously a tax, and was meant to be. It should be noted that after repeated raids on the Road Fund, the Treasury gave up all pretence that this class of revenue constitutes a self-balancing item, and in the accounts for 1937-8 the proceeds of motor licences were merged in the general accounts and appeared above the tax line. That is to say in 1936-7 motor licences were not taxes for official and statistical purposes: in 1937-8 they were.

Thus even the orthodox published accounts cannot be accepted uncritically as a source for the calculations we have in mind, but the difficulties of the investigator are greatly increased when fiscal transactions are not merely shifted above or below the line, but are taken out of the main accounts altogether. A striking example of this is provided by the Wheat Scheme, which has been in operation since 1932. Under this scheme a levy was made on every miller and every importer of flour. The proceeds of this levy were used to make up to the home wheat-grower the difference between the market price of wheat and a standard price (at that time 45s. per quarter). This was in effect a subsidy to the home-grower of wheat. The revenue to meet this expenditure was, however, not collected and distributed by the Treasury, but by a subsidiary of the Treasury—namely, the Wheat Commission. In the U.S.A. such a levy is frankly acknowledged to be a tax, and is called a processing tax, and the payment to the farmer is seen to be a subsidy out of public funds. But here this patent device, which is a purely administrative device, creates the extraordinary delusion that neither a subsidy nor a tax is involved. When the Wheat Bill was introduced, the Minister of Agriculture stated that no contribution from the Exchequer by way of subsidy would be involved. The Wheat Commission itself, after five years' experience of the working of the scheme, began its report with the claim that the Wheat Act of 1932 provided financial assistance and marketing security for wheat growers in the U.K. by a scheme which was novel in character and involved no charge upon the public funds. The serious student is not deluded by this argument, and in any calculation of subsidies to agriculture in this country the wheat levy is included with the direct subsidies (see "State Expenditure on Agriculture in 1938-9," *Journal of the Royal Statistical Society*, Part IV, 1938). Even the Minister of Agriculture did not forget to include the wheat levy in the list of blessings when he reproached farmers for their ingratitude for past and present favours.

The purpose of this device is clear. The sums do not appear in the Budget accounts, and the transaction is immune from annual Parliamentary review and criticism. When a direct subsidy was given to sugar-beet-growing, uncomfortable publicity was attached to periodical Parliamentary criticism, which took the form of demonstrating that it would be cheaper to import the amount of sugar involved, give it away and pension off the entire home beet industry. *The Times* of November 25th, 1933, had a leading article on the "unnecessary beet-sugar subsidy," which at first glance suggested a surprising and belated change of attitude. But what emerged was that *The Times'* objection was only to the fact that "a valuable experiment was being financed in the present crude way by the general taxpayer," whereas consultation between the producing, refining and distributive sections of the sugar industry had now reached the stage when the same results could be secured by a marketing scheme. "The unification of the whole sugar industry offers a clear chance to relieve the general tax-payer of a heavy burden now without exciting implacable hostility in any one—except possibly Sir Herbert Samuel." This simply meant that taxation could be levied outside the records of the ordinary public accounts, and it is a tribute to Sir Herbert (now Lord) Samuel's acumen that he is not taken in by this fiscal jugglery, since there is hardly any limitation to the exploitation of this device.

Taking the Wheat Scheme as a model, an amusing parlour game suggests itself to students of public finance—namely, to empty the Budget of as many items as possible. (Incidentally, it may be asked whether the Unemployment Insur-

ance Scheme is not another example of a tax merely disguised by its administration as an autonomous fund). A levy on marriages, with an independent fund administered by the Registrar-General, could take the maternity and child-welfare services out of the Budget. Some years ago the Bursars of Oxford Colleges exhorted the Minister of Agriculture to regulate livestock in the interest of College revenues. If there is this intimate relation between butchers' meat and higher education, a 2d. levy per lb. collected from the meat firms could furnish the University grant. An autonomous fund raised by a levy on crime novels would make the Secret Service fund really secret. A National Entertainment Board could "process" after-dinner speakers and take over the Government Hospitality Fund. The Stock Exchange might process security dealings and take over a slice of the National Debt.

Experienced persons used to holding company devices would, however, ferret out these separate funds and gather them into a consolidated account, from which an estimate of the real total of taxation could be derived. In the case of wheat the following figures would be garnered:

				£Mn.
1932-33	...	...	...	4.8
33-34	...	...	...	7.2
34-35	...	...	...	7.0
35-36	...	...	...	5.9
36-37	...	...	...	1.4

But this countermove is completely baffled by another form of concealed taxation: the scheme which acts as a subsidy to industry, but does not necessarily involve the collection of a general fund by an outside body for subsequent transfer to the industry. If, instead of a grant from the Exchequer which passes through the main account, or a levy which side-tracks the main account, the assistance takes the form of the grant of monopoly powers, then statistical computation of tax impositions becomes impossible. An example is the Milk Scheme. Neither directly nor indirectly can a lump sum be detected which represents a subsidy to the industry, but it cannot be denied that powers have been given to levy a toll on the inhabitants of this country.

For the complete discomfiture of any person who might attempt an estimate of the value of this assistance by calculating what the price might have been without the scheme and comparing this with the achieved market price, the scheme operates as a discriminating monopoly. The following is an example of the price structure set up by the Board:

*Realized Price per Gallon of Milk, in Pence*

For liquid consumption	... 15.08	For tinned cream	... 5.0
„ butter	... 4.07	„ ice-cream	... 7.50
„ cheese	... 3.50	„ chocolate	... 8.00
„ soft cream-cheese	... 7.50	„ sterilized milk for export	... 6.00
„ condensed milk	... 6.0	„ products not specifically	
„ condensed milk for export	... 4.04	mentioned	... 7.00
„ milk powder	... 4.50		
„ fresh cream	... 7.50		

It could be argued that, with free entry into the industry, any subsidy is eventually dissipated and the total proceeds of milk sales will not contain a tax element. But inside the scheme there remains a complicated system of levies and subsidies operating between various sections and classes of the community. We can imagine a family consuming milk in liquid form, and through the medium

of butter, cheese, ice-cream and chocolate. How does it emerge in respect of taxation? If father ends the day with a glass of hot milk laced with two spoonfuls of rum, a meticulous estimate can be made of the sumptuary levy swallowed with the rum, but the milk goes down apparently free of duty. Similarly the Customs and Excise accounts purport to give an exact total for the taxation derived from beer, but do not allow for the mulcting of the beer-drinker through the Hops Scheme. What this scheme really involves in the shape of a subsidy can be gauged from the following note taken from the Estate Market column. It related to the sale of a farm with 14 acres of hop gardens.

"If the purchaser of Trillinghurst Farm does not desire to have the Basic Hop Quota transferred to him by the vendor for the purpose of growing hops on Trillinghurst Farm or other farm or farms that he works at the time of the sale and shall give notice thereof in writing to the vendor within 14 days after the date of contract, then he shall be deemed to purchase Trillinghurst Farm and not the Basic Hop Quota therewith and his purchase price shall be reduced by the sum of £2,500."

Other schemes effect similar results by other novel devices. What taxation is involved, for example, by the device of the potato riddle? The situation becomes still more fantastic when the powers associated with a scheme are quite nebulous, but none the less have considerable value in action. Somehow or other a project for sinking a new coal-shaft in South Wales necessitates an official enquiry, before which the representatives of Scottish and Northern coal-owners can appear with objections which effectively quash the project. In a similar way, the iron and steel industry seems to have acquired an unofficial veto which can prevent or hold up new development. All these various powers have a cash value to industries, and financially it is a matter of indifference to the recipients whether this cash value is obtained directly from the Exchequer or by these circuitous methods. The supreme advantage of the indirect method is the obscurity which surrounds the process of levying a toll. There is no reason why such powers granted to industries should not be enhanced and the Government, by sharing the monopoly gains, secure a positive and not merely a negative relief to the Exchequer. In this case we should be back to the old Elizabethan monopolies.

But we have already gone so far in this direction that one may legitimately ask whether any value or significance attaches to statistics such as those prepared for the Colwyn Report on National Debt and Taxation, which purported to work out to the nearest penny the tax burdens on various ranges of incomes. Let any one who fancies the task attempt to calculate for 1938 the "tax burden" on a £500 income entailed by the "orthodox" taxes and the repercussions of the hops, milk, pig, bacon, potato and herring marketing schemes, the Coal Mines Acts, the Cotton Spindles scheme, the legislative restrictions on transport and the virtual autonomy conferred on the iron and steel industry. I pass over Government-fostered international schemes such as rubber and tin restriction. Various attempts have been made to bring these calculations up to date, and I suggest that such attempts are a sad waste of effort. They are also politically dangerous in their suggestion that certain classes may not be bearing their fair share of taxation. The sequel to this war will certainly not be the nationalization of the means of production and distribution, but we are likely to experience an extension of the compromise Socialism in favour before the war, and an



**TABLE B**  
*Relating Direct and Indirect Taxation to Specimen Incomes.—Year 1925-26*

Income	Income Tax and Super Tax		Death Duties		Total Direct Taxes		Tea	Sugar		Tobacco	Alcoholic drinks		Entertainments
	Income wholly earned	Income half earned, half investment	Income wholly earned	Income half earned, half investment	Income wholly earned	Income half earned, half investment		Income wholly earned	Income half earned, half investment		Income wholly earned	Income half earned, half investment	
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.		£ s. d.	£ s. d.	£ s. d.
100	—	—	1 2 0	1 2 0	—	1 2 0	11-0	1 17 6	2 15 0	2 15 0	6 3 0	6 3 0	3 0 0
150	—	—	1 11 0	1 14 0	—	1 14 0	12-0	2 3 9 3	4 0 0	4 0 0	10 3 0	10 3 0	4 0 0
200	—	—	2 15 0	2 5 0	—	2 5 0	12-9	2 5 3 6	4 15 0	4 15 0	12 3 0	12 3 0	5 0 0
500	10 3 4	14 6 8	6 15 0	21 1 8	10 3 4	21 1 8	12-9	2 7 6 6	5 0 0	5 0 0	12 0 0	12 0 0	12 0 0
1,000	81 3 4	97 16 8	17 3 0	114 19 8	81 3 4	114 19 8	12-9	2 7 6 6	6 15 0	6 15 0	18 0 0	18 0 0	1 12 0
2,000	204 10 0	281 3 4	64 18 0	346 1 4	264 10 0	346 1 4	12-9	2 7 6 6	7 10 0	7 10 0	28 0 0	28 0 0	1 12 0
5,000	1,095 15 0	1,095 15 0	316 3 0	1,411 18 0	1,095 15 0	1,411 18 0	12-9	2 7 6 6	9 13 0	9 13 0	50 0 0	50 0 0	2 5 0
10,000	2,995 15 0	2,995 15 0	890 17 0	3,886 12 0	2,995 15 0	3,886 12 0	12-9	2 7 6 6	10 4 0	10 4 0	105 0 0	105 0 0	2 15 0
20,000	7,370 15 0	7,370 15 0	2,553 18 0	9,924 13 0	7,370 15 0	9,924 13 0	12-9	2 7 6 6	10 4 0	10 4 0	105 0 0	105 0 0	2 15 0
50,000	22,120 15 0	22,120 15 0	6,621 18 0	28,742 13 0	22,120 15 0	28,742 13 0	12-9	2 7 6 6	10 4 0	10 4 0	105 0 0	105 0 0	2 15 0

Income	Cocoa, coffee and chicory, dried fruits, patent medicines and table waters	Total indirect taxes		Total taxation		Total taxation : percentage of income			
		Income wholly earned		Income half earned, half investment		Income wholly earned		Income half earned, half investment	
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	Direct	Indirect	Direct	Total
100	s. d. 6 0	11 17 6	12 19 6	—	—	—	11-9	1-1	13-0
150	6 6	17 9 3	19 3 3	—	—	—	11-6	1-1	12-7
200	6 9	20 7 9	22 12 9	—	—	—	10-2	1-1	11-3
500	6 9	20 19 0	42 0 8	2-0	2-0	2-0	4-2	4-2	8-4
1,000	6 9	29 2 0	144 1 8	8-1	8-1	8-1	2-9	2-9	14-4
2,000	6 9	30 19 0	386 10 4	13-2	13-2	13-2	2-0	17-3	19-3
5,000	6 9	1,161 0 0	1,477 3 0	21-9	21-9	21-9	1-3	28-2	29-5
10,000	6 9	3,117 1 0	4,077 18 0	30-0	30-0	30-0	1-2	38-9	40-1
20,000	6 9	7,492 1 0	9,745 19 0	36-9	36-9	36-9	0-6	48-1	48-7
50,000	6 9	22,242 1 0	28,863 19 0	44-2	44-2	44-2	0-2	57-5	57-7

Taken from Report of the Committee on National Debt and Taxation, Cmd. 2800, 1927, pp. 94, 95.

elaboration of industrial and agricultural schemes which by their monopolistic character will more and more narrow the range of free market prices and pepper the system with elements of concealed private taxation.

It is obvious that in such a system it is impossible to mark off the field of taxation and to compile fiscal statistics of any accuracy. But even if it were possible,\* the question would remain what significance attached to such statistics, especially in relation to the concept of burden. Here we come to one of the problems which Mr. Keynes has denounced as the humbug of finance—the confusion between the real and the monetary, which at the moment tends to bedevil our war economics, as will be noted below. In the first place, we can ask whether the concept of burden has any meaning as applied to the collectivity known as the nation. In what way does the taxation levied in the U.K. represent a burden upon the total population of the U.K., particularly in comparison with taxation levied upon other collectivities. Nobody, it is asserted, is so unsophisticated as to suppose that the revenue collected by the Treasury is thrown by that august body into the sea. Nevertheless the concept of burden suggests a deprivation which popular controversy interprets into the equivalent of a holocaust or a wholesale jettisoning of cargo. “Taxes mean bareness of furniture, of clothing and of the table.” If the taxation is used to pay an indemnity to a foreign country or to pay interest abroad on non-productive debt, the transfer of purchasing power entails an export of goods and services with no material return, and there is a sacrifice or burden involved. But what net sacrifice to the community as a whole is imposed by taxation which is promptly redistributed inside the country? Let us suppose that a sum of £10 mn. now raised for the hospitals by street collections is provided out of the Exchequer and that the street collections are banned. The Budget total will increase by £10 mn., and the next Parliamentary answer will show that John Bull has increased his lead in the international competitive tax-burden race by 5s. per head. But what real change has occurred? Under the first method £10 mn. worth of the country’s real resources were devoted to the provision of hospital equipment and services; under the second method £10 mn. of real resources are still devoted to the same purposes. True there is a change in the distribution of the contributors, and this will have repercussions running through the whole system, but the notion implied by the fiscal statistics that a new burden has been imposed on the community is quite fallacious. Let me take a more blatant example which I used in a previous discussion before this Society. Let us assume that the women of this country spend £30 mn. a year on cosmetics, and that it was proposed to provide these aids to beauty through the medium of the Exchequer. I imagine that even some of the gentlemen who rebuke deans for pessimism about the country’s finances would regard this as the last straw. The cosmetics could be provided by the State taking over the industry and selling the products to willing buyers. In that case the service would be on the lines of the Post Office, and in the Finance Accounts the item would be shown in the self-balancing group. No one could claim that the arrangement represented a burden, nor that any increase over time was any more objectionable than in the case of increased use of the Post Office. The only issue at stake would be whether the State was likely to run the industry as efficiently as private enterprise already

\* If I had to draw the line between devices which entail “tax burdens” and those which do not, I should mark off on the wrong side any intervention which prevented free market operations in the factors involved or the products themselves.

does. But suppose the State provided the cosmetics free and raised the necessary revenue by imposts such as the income tax. Again if £30 mn. was retained as a limit, the essential fact before and after is that that amount of real resources is devoted to the production of cosmetics. If John Bull cannot see this, he is like the husband who willingly signs cheques to the amount of £100 a year for his wife's dress bills, but yells blue ruin if she asks for a £2 weekly dress allowance instead. This is the collective effect, but the distribution of the individual contributions would be different, and a genuine controversy would arise on this point. In the present state of opinion we should naturally expect that some citizens would object to paying for the garnishing and raddling of other citizens' womenfolk, but this would be more of a political than an economic problem. In course of time it might become generally accepted that the provision of cosmetics was part of the social services, and even be acknowledged that the absence of shiny noses improved the landscape and constituted an amenity which enhanced the general welfare.\* Once that stage had been reached, both the political and the budgetary problem would be solved. "All balancing the budget ever can mean is that an institution has achieved public acceptance of its objectives. If it has there will never be any difficulty about balancing its budget."†

An increase in the expenditure on this service beyond the £30 mn. would have no greater significance than an increase in any other public service. In what way, then, would British industry be handicapped? The building industry would not be less prosperous if it built cosmetic factories as an alternative to other types of factories. Employment in the cosmetic industry does not differ in any essential way from employment in, say, the paint and varnish, or, indeed, any other industry. Great Britain would be a country in which the cosmetic industry was relatively more important than in other countries where no such authoritarian stimulus to the industry obtained. But she would suffer no burden nor be handicapped in her general competitive power in the world markets. Nevertheless Mr. Asquith once argued that while expenditure on such things as education appealed to our higher nature, it did not "grease the wheels of finance" like expenditure on the Post Office. It may be asked why the finance of the building industry should run less smoothly if it is occupied in building schools rather than branch post offices, why local tradesmen should suffer because their clientele comprises more teachers and fewer postal officials, why house rents should be any different under the one form of expenditure rather than the other. In particular, why should the distribution of individual incomes be affected more in one direction than another? Surprise is frequently expressed because the number of surtax payers showed no spectacular diminution as a result of the heavy taxation brought about by the last war. Considering that the figures relate to incomes before deduction of taxation, it is not surprising that they show no tendency towards greater equality. It is quite possible that increased taxation, with its concomitant of increased State expenditure, might result in still larger gross surtax incomes. Expenditure on roads might enhance fortunes in the cement industry, and larger old age pensions go to swell

\* Since writing the above I have read somewhere the announcement that henceforth ammunition and other war factories employing girls would supply free face cream and powder in the dressing-rooms. On a cost plus basis you, gentle taxpayer, have already caught up with my propensities.

† T. W. Arnold, *The Folklore of Capitalism*.

the incomes of chain-store proprietors. It would be very churlish of a newspaper proprietor to complain of the burden of the social services, considering that his clientele has been built up by three-quarters of a century of compulsory education. Once a new setting has been given to demand by authoritarian action it is difficult to determine which persons have experienced a net benefit and which a net loss. At the outset, no doubt, the gains and the losses are in some cases patent, but in a comparatively short run the whole position is obscured by the repercussions of the changed direction of demand. No one is justified in comparing the 1913 rate of income tax (1*s.* 3*d.*) with the present rate to calculate how much better off he would be at the former level of taxation. He can calculate the amount of the tax difference, but he cannot calculate what his income would now be in the conditions of a 1*s.* 3*d.* income tax. The only person who can claim that taxation imposes a burden on him is one who is so unspecific in his innate and acquired qualities that he is confident he would earn his present salary (or at least more than his present income less taxation) whatever the structure of the community's demand schedule. How many persons could assert that? I suggest that the concept of the burden of taxation be dropped from scientific discussion, or at least modified out of all recognition. I also suggest that the utmost circumspection be observed in any compilation of statistics purporting to measure burdens. I think myself that theories of public finance will in future be concerned much more with questions of employment policy and social welfare than with the ancient problems of incidence. I concede that an important problem of the effect on incentive will still remain for discussion, but this will involve political and psychological calculations rather than economic analysis. There are also possibilities of the tax machine being overstrained, but this is an imponderable dependent upon developments in administrative technique.

In spite of this conclusion there is one purpose for which the concepts and measures of burdens can be usefully retained. Taxation may involve "bareness of furniture, of clothing and of the table," as we can see today. John Bright in this phraseology was denouncing the cost of the Crimean War and, while it is true that expenditure on armaments does not adversely affect employment, depress all industry and reduce the grand total of incomes (indeed, with the deficiencies of our peace-time monetary management it may do the reverse), the diversion of resources to the production of goods and services which from the point of view of the general welfare, if not of pure economics, satisfy no real wants, represents a real burden on the community. It is perhaps because in the early history of public finance State expenditure was mainly incurred for military purposes that the association with the concept of burden arose. Only in this context can I see any justification for the concept of taxable capacity set down by Mr. Findlay Shirras in a paper read before this Society (Vol. LXXXVIII, 1925, Part IV), "Taxable capacity is the total surplus of production over the minimum of consumption required to produce that volume of production" with its recondite qualification "the standard of living remaining unchanged." But it would be a mistake to assume that the measure of the burden—the real cost of a war—can be deduced straightway from the public finance accounts. The humbug of finance—the confusion between the real and the monetary aspect—still bedevils our thinking on this problem. Most people still believe that an increase in the soldier's pay would increase the real cost of the war to the nation. Some people still think they are helping the war effort by writing more letters

so as to swell the revenues of the Post Office. Others believe that by petrol rationing the Government is depriving itself of revenue and thereby of resources, as if the more petrol that is consumed by private persons the more petrol the Government can command for the waging of the war. Even the Government itself has declared in an advertisement that the hoarding of money under a mattress is "as good as robbing the soldiers"—a perfect example of the money delusion. When we ascertain from the budgetary figures that the war is costing £4,000 mn. a year, we are inclined to accept that figure as a measure of the sacrifice entailed. From the information that over half the national income is spent for that purpose it is facile to assume that the peace-time standard of living has been reduced in the same proportion. Fortunately this is not the case. Not all of the £4,000 mn. diverts resources into the production of guns, aeroplanes, tanks and warships—things out of which no belly gets a material comfort. Some of it is spent on food, clothing, and creature comforts for the Forces, and these things would have been produced and consumed in peace-time. The regimental barber is not diverted from his peace-time activities: he does the same work in uniform. Soldiers' family allowances are levied from the community *qua* taxpayers, but returned to it *qua* consumers. Subsidies to keep down the cost of food are collected into the Exchequer and in effect redispensed to the civil population. On the other hand, some resources are diverted to war effort, but without monetary cost. Voluntary fire-watching entails a sacrifice of leisure or sleep, or even of positive output, without any trace of the sacrifice being recorded in the Exchequer accounts. When private employers make up the peace-time salaries of serving soldiers, the army pay books do not record the full monetary cost, but this does not matter, since the real cost is not the pay of the soldier, but the loss of his peace-time output. To get the notion of real cost we have to calculate what goods and services are being produced which no sensible person would regard as of the slightest benefit to human welfare under peace conditions or, alternatively, what proportion of the occupied population is engaged in rendering such services. The calculation is difficult if not impossible, but I suggest that an attempt at it might be justified, if only to correct the misapprehensions created by preoccupation with the tax accounts.

With the aid of the statistics furnished in the White Paper which now accompanies the annual Budget such an attempt can be made, and the following calculations are based on the White Paper figures. Here is a summary of the real cost of the war to this country in 1941. The figures given for personal expenditure on consumption goods include an estimate of the income received in kind by the Forces, and relate therefore to the whole population. In 1941 the value at market prices of total consumption was £3,863 mn. as compared with £3,584 mn. in 1938. No satisfactory index of prices can warrantably be applied to reduce the 1941 total to the 1938 basis, but if an increase of roughly 30% is assumed the adjusted 1941 total is about £3,000 mn., showing a 16% quantitative reduction on the peace-time volume of consumption. If this adjustment is accepted, the real sacrifice ("burden") on the consumption side can be presented as follows. In return for greater effort and strain, which can be subsumed as a sacrifice of leisure, the community has in addition suffered a quantitative reduction in consumption of one-sixth, and a further unmeasurable qualitative reduction represented by limitation of choice and reduction in the standards of still available goods and services, as manifested for example by the added discomfort of transport and the use of substitute and inferior materials.

In addition there is the encroachment upon material capital. In 1941 assets of gold and overseas investments were realised to the extent of £800 mn., the damage and destruction of property figured at £250 mn., and the net depletion of fixed equipment, stocks and other working capital at £500 mn. This gives a total capital loss of over £1,500 mn. for that year, loss to this country, that is, since the gold and overseas investments have passed to other hands and not out of existence. Against this total must be set the capital acquisitions of the Government. The depletion of stocks in private hands was partly attributable to sales to the Government, which may have accumulated stocks in 1941. Some of the war expenditure by the Government is on capital equipment which will have an economic value after the war. Some sites will have an undoubted value, buildings and machinery a possible value. If the generous figure of £400-500 mn. were allowed for these items, this would correspond to the net peace-time increment in capital (£406 mn. in 1938). Thus in one year the legacy to posterity of actual and potential capital was reduced by £1,500 mn., and to that extent the future will bear the real cost of the war in that year. Hence for 1941 a current reduction in consumption valued at £600 mn. at pre-war prices, and a depletion of actual and potential capital by £1,500 mn. would represent the real burden imposed by the war. I hope I shall not be regarded as a cold-blooded statistician if I recoil from any attempt to set an economic value on lost and maimed human life.

#### DISCUSSION ON MR. SCHWARTZ'S PAPER

PROFESSOR G. FINDLAY SHIRRAS: It is with much pleasure that I propose the vote of thanks to the reader of this suggestive and witty paper. Its great value lies in the fact that it draws attention to the limitations of fiscal statistics. This is especially interesting to me, as the University College at Exeter has just completed an Enquiry into the Burden of British Taxation under the aegis of the National Institute of Economic and Social Research. The caveats of Mr. Schwartz, indeed, have been anticipated. In our enquiry, the burden of taxation in the pre-rearmament year, 1937-38, and in the third year of the war, 1941-42, has been calculated on various ranges of incomes. We have been careful to set out the basis of the estimates, the definitions, and the assumptions. The picture is not quite complete. It covers at least three-fourths of the levies which the community imposes on its members, but we are not able to allocate the remainder to individual incomes, although of course these are allowed for in the calculation of the total burden.

When such an Enquiry is made, there are assumptions on which the calculations have to be based, and we have gone out of our way to repeat the assumptions and limitations. The first is that the estimates relate solely to the burden placed on the citizen by the financing of the State; they take no notice of any advantage he derives. Another caveat relates to the accuracy of the figures, and Mr. Schwartz has pointed out some of the possible inaccuracies. The burden of income tax and surtax can be assessed with tolerable precision, but the burden on any particular income of every other tax can be assessed only with the aid of certain assumptions, and we have made it plain that although the results are printed with an air of precision, they must be understood as approximate. Again there is the question of incidence, not specifically mentioned in the paper. A tax may not be borne by those who pay it in the first instance, but we cut the Gordian knot by assuming that the taxation burden is borne as it was intended, and if in an enquiry like this the basis of the estimates, the definition and the assumptions are made clear I think the results may be valuable.

Mr. Schwartz's references to concealed taxation are timely and apposite. We have included as taxes compulsory contributions in connection with the social services, also fees charged for special services which people are compelled to accept, especially when the fees are, as in motor licence duties, more than the cost of service rendered or where the possible service rendered is absent. Similarly Post Office net revenue is regarded as taxation. As the writer of the paper points out, the State to-day is subsidizing agriculture and industry, and is frequently doing this by concealed special taxes. Where the subsidy takes the form of monopolistic price-fixing one cannot trace the amount of subsidy involved, and what part of the price can be regarded as tax is a matter of argument. Such cases must be neglected in the calculation of the burden. In other cases the amount of the tax, whether included in the Exchequer returns or not, can be identified. In the case of sugar, the structure of the tax is such that the aggregate amount of duties paid by the consumer is more than the amount received by the Exchequer, the difference benefiting the sugar producers at home and in the Empire. This can be estimated at £8 millions for 1937-38 and in 1941-42 was of the order of £10 millions. The levy on flour-milling and the coal levies are taxes paid by the consumer. The former amounted to £1·7 millions in 1937-38 and the latter to £3 or £4 millions in 1941-42. We did not include the burden on individual incomes of local rates, taxes on business profits, contributions to the different compulsory War Damage Schemes and certain small items, but these have been included in the total tax burdens. Mr. Schwartz has not referred to death duties; some authorities hold that these should not be included in the burden of taxation on incomes, as these are not assessed on income, but neither are any of the indirect taxes. That they are not levied annually is a matter of administrative convenience and, however assessed, death duties are paid out of income or have an effect on income. An estimate of the burden must be included with the burden of other taxation when the total burden on investment incomes is under consideration.

One important matter on the measurement of taxation burdens in various countries demands a brief reference. Suppose it is desired to compare the burden of taxation, say, in this country with that of the United States. How should this be done? A comparison of the absolute money burden of total taxation per head merely shows that the average in one country is higher than in the other. We should be careful to compare the same things, and the best method is to find out the proportion of taxation to net national income at factor cost after allowance for depreciation.

I should like to thank Mr. Schwartz very much for the points he has raised, although I cannot agree with everything he said. I should like to take this opportunity, the first since I ceased to be an Honorary Fellow on my return from India, to say how much we overseas Fellows owe to the Society and how valuable its Proceedings are to statisticians in other parts of the Empire. I speak not only for myself, but for many others.

MR. F. W. PAISH, in seconding the vote of thanks, said: I should like to re-emphasize what I think is the central point of the earlier part of the Paper, that while it is quite possible under certain assumptions to estimate tax payments, it is not possible to estimate tax burdens without reference to the objects on which the money is spent. It is quite possible, for example, that a man with an income of £100,000, who is paying £94,000 in tax, is in fact getting practically the whole of his income back indirectly, and that if taxation were abolished and the State stopped doing anything, he might find his income going down, not to £6,000, but perhaps to £250.

Mr. Schwartz missed out one or two things which should be estimated in taxation. The taxing power of public utilities was one. There are people in the City of London who consider that their water rate is a very substantial contribution to taxation. On the water rates of London it would be interesting to work out who is being subsidized and who taxed, but I am sure there is a substantial element of taxation.

Of course, the real burden of taxation and expenditure by the State can only be assessed if first of all one inquires how far the State differs from private enterprise in efficiency, and, secondly, how far the State as a whole is gaining or losing by the redistribution of income which is done through the State's discriminating monopoly. How far, for example, is the country better off because the Post Office subsidizes postages to distant places like the Outer Hebrides or New Zealand at the cost of people whose postage is only carried a short distance, as in the City of London? Is the country better or worse for it? Whether or not there is a substantial burden is open to argument. There may be a loss in this distribution of income not always in favour of the poor by taxation of the rich. It is a point upon which different opinions can very well be held.

On one or two points Mr. Schwartz tended to under-estimate the burden on consumption imposed by the war, particularly by his side reference to loss of leisure. Some of the loss of leisure is included in his figures of cost. I presume that expenditure on domestic service is included. In the case of a middle-class family which before the war had two domestic servants, and the wife now does all her own housework, this would be shown as a reduction in expenditure, although in fact it is a sacrifice of leisure. Another example is somebody who, but for the war, would have been able to get a vacuum cleaner, and now has to do the work by hand.

One has to add in a great deal of the loss of leisure as a fall in standard of living. One already adds in some, but not enough. Further, I think there is good ground for including additional compulsory work, such as fire-watching or Home Guard, as part of taxation. If in a primitive community the tribe was told to go out and make roads in its spare time we should agree that that is considerable additional taxation, and where people have to spend 48 hours a month on fire-watching there is a good case for assessing that at 1s. 6d an hour, and thus adding £200 or £300 millions to our war expenditure and taxation.

As for capital loss figures, we cannot add in, I suppose, the loss of capital owing to the reduced effectiveness of the expenditure on education. But we are using up our capital as our people who have had better education die off or are killed off, and the people coming on have not had the same advantages. It may be merely that it is not a loss of capital but an absence of the addition which we might have had. It may be that the education which children receive even in war-time is better than their fathers had, though worse than their elder brothers had, and that it is a case merely of not receiving the capital increment we might have expected. But I think there is no question of the loss to the community of the unpaid work done in the home. A tremendous amount of work has been diverted from the home to industry. That is not a net gain. The people concerned were doing something before they went into munitions; very largely they were bringing up and looking after children. Now the children are not being brought up and looked after, and this is reflected in additional juvenile delinquency. But the real burden must include the absence of parental control and care in bringing up, as well as education of the rising generation, and this will be not the least of the capital deficiencies we shall have to try to make good in the years immediately after the war.

DR. E. STERN said he was glad that Mr. Schwartz had set out to destroy certain prejudices as regards taxation—prejudices which proved to be very costly—but he was rather astonished that he should have stopped short of the main hurdle, namely, war expenditure. He set out to build up a new conception of the burden of taxation, quite properly, since there was no sense in calculating a burden if one had not a proper conception of the burden. In doing so, he went astray, however, in his attempt to classify by distinguishing between so-called war expenditure proper and war expenditure that was only a substitute for peace expenditure. In Mr. Schwartz's opinion guns were not a source of satisfaction. Nor, in the present speaker's opinion, were police truncheons, but both were prerequisites of security in the world in which we were living. There-



fore war expenditure belonged to the category of cost of production. Some of the expenditure might be wasted, just as it often happened that certain constituents of the cost of production in industry were wasted. This did not make all costs of production a waste; the criterion by which to calculate what was cost of production and what burden was how much the expenditure helped to improve the production. One had only to reflect on the possibility of every company having to provide a guard for its own factories, or to provide its own convoys for bringing its goods across the sea to realize how tremendously the cost of production would rise if this were not done co-operatively by the State, the costs being levied on the community as a whole.

In general, war expenditure was part of the costs of production, and no burden. It became a burden if it was wasted and put to inefficient use. The criterion was not whether war expenditure was a substitute for peace expenditure, but whether the use to which it was put was efficient or inefficient. Once a proper conception of the place of public expenditure was formed, there would result quite a number of consequences in other fields of economic policy. He could not enter upon them now, but would point to one of them—the preparing of a proper basis for re-considering the question of capital loss in war.

MR. T. BALOGH thought that Mr. Schwartz had taken a very orthodox view of the “cost” of the war. If the psychology of the matter were considered surely they could not say that “fortunately, they did not spend so much on the war effort.” It seemed to Mr. Balogh that if they sought the “satisfaction” aspect most of them would have been much happier if the war expenditure had been a great deal higher. Many economists wanted it to be very much higher. Nor could he understand Mr. Paish’s pessimism. Mr. Paish had talked about the terrible loss to family life and to the children of the country. But surely many children had gained enormously as a result of the war. For the first time the slum children had been transported to the country. For the first time for many years there had been economic security in many parts of the country such as had not been known since the last war. If they were to talk about these social aspects of the war-time situation, they must look beyond their own immediate circumstances as middle-class economists who had been brought up in very comfortable situations and had enjoyed security in both peace and war.

But he wanted to support very heartily the author’s attempt to demolish the “humbug statistics” exemplified in the White Paper analysing the sources of war finance. The White Paper endeavoured to show the catastrophic impact of war on the richer people. Obviously if they merely regarded the fact that bankruptcy was threatening people with earned incomes these statistics were interesting, and it was paradoxical in the extreme that the “liberals,” wishing to stop inflation and preserve “individualism,” should inflict taxation on earned incomes so vast as to undermine the social structure instead of financing the war by rationing and forced saving. But then it was this formalistic “orthodox” approach of the “liberals” which made Hitler triumph in Germany. His main impression was, however, that Mr. Schwartz had furnished a most reasoned argument against the usual concepts of taxation and tax burden. He would merely ask him whether henceforth everything must be regarded as a burden which modified the distribution of income as it would come about as the result of a perfectly working free competitive system. That view surely was as little justified as the approach of the Colwyn Committee.

DR. R. G. HAWTREY thought that the discussion was in some danger of getting away from the question of fiscal statistics in considering the indirect gains and losses of war-time measures. Possibly Mr. Schwartz started by not distinguishing quite clearly enough between accounts and statistics. The Exchequer account was an *account*, and did not pretend to present statistics. There were things that were excluded from the Exchequer account because they did not pass through the Exchequer. That might be a retrograde arrangement, for when the Consolidated Fund was created the intention was that all forms of impost

should pass through the Fund. The wheat levy was made an exception to that. However, that was a mere matter of the form in which the accounts were kept, and it was open to the statistician to collect the information wherever it was given.

Mr. Schwartz had pointed out, quite rightly, that there were a number of schemes which in one way or another threw a burden on the consumer, and the burden was utilized in some form of concealed or indirect subsidy. The sugar duty, for example, involved a subsidy of eight millions or so to the home and colonial producer. It was extremely difficult to draw a line between what ought and ought not to be reckoned as a tax. Some enthusiasts would say that a protective import duty on a manufacturing industry was no burden at all, and it was almost impossible to calculate what the net burden was. These borderline cases made any precise quantitative estimate of the burden of taxation on the community impossible. The qualifications to be applied to any estimate depended on the purposes for which it was to be used.

Mr. Schwartz, in calculating the cost of the war, had made use of the statistical material of the White Paper, which was of course derived from the Exchequer account. The cost of the war was merely the expenditure from the vote of credit, subject to his qualifications as to change of price level and so on, and he had analysed it into such matters as the reduction of consumption, the increased effort, and the withdrawals of capital, which totalled up more or less to the vote of credit. Thus one came back to something not very different from the Exchequer account, subject to all the refinements that a statistician would introduce into it.

Towards the end of his Paper Mr. Schwartz arrived at a distinction, which surely was no novelty, between beneficial and onerous services. There was a certain confusion of thought when he defended the onerous services as being in a disguised form beneficial, in that the people employed on them consumed like other consumers. For as certain passages in his paper quite clearly showed, the loss consisted, not in the failure of the people employed to consume, but in the fact that what they produced was not devoted to the benefit of themselves and their neighbours. It could in a sense be assumed that all the onerous services were beneficial, because war itself was "beneficial" to the community as a necessary evil. But the cost of the onerous and beneficial services and of the transferred services, like the payment of old age pensions and the interest on national debt, could be distinguished.

THE PRESIDENT, after a reference to the stimulating value of the Paper, said that he regretted that the author had not been with him at an earlier meeting that afternoon with a number of members of Parliament who were discussing the problem of family allowances in connection with another White Paper. It had been argued at that meeting that another £125 mn. a year would be added to the burden on the community if family allowances were granted, although the £125 mn. would be redistributed to parents at the rate of 5s. per week per child. This kind of discussion was a good illustration of the author's thesis that the fiscal statistics in their present form and taken simply as fiscal statistics did not get one very far.

Obviously to pay a tax of £125 mn. in order to redistribute exactly the same sum to the parents would not add to the burden of the total community in the very least. Already about £80 mn. a year was remitted from the income tax of people who had children, and one could play with the figures in almost any way one liked in order to produce any apparent addition to the burden of taxation. If it was decided that the people who were receiving this £80 mn. remission were not to share in the family allowances, then the family allowances would add, not the difference between £125 mn. and £80 mn., but the difference between £125 mn. and £69 mn. to the taxes (the new figure was accounted for by the fact that the £80 mn. included a certain number of people who were getting more than 5s. a week back per child, actually they were getting 9s. 6d.). If it was decided that these people were to get the allowance in addition, the whole

£125 mn. would be added to the fiscal statistics. But there was no additional burden to the community as a whole.

Just one other of his own personal interests was touched upon in the Paper. The author suggested almost deprecatingly that possibly the Unemployment Insurance Fund and contributions were also a form of taxation and a burden to the community. Obviously it was a tax on employment, and so far as it fell on employers it was part of the cost of production. It was tax he paid for each week of employment that he gave, and yet, of course, it did not appear in the national budget. What should be done about that was related to another point the author had made—the question of incentive. Whether by putting this tax on employment the employers were given an incentive to reduce their employment to a minimum he did not know. He did not himself think it had much effect. But he agreed that the question of the bearing of a tax on incentives to do this, that, or the other thing was an important matter. He had played with the idea of substituting for the tax on employment a tax on dismissals or a tax on unemployment.

It was important to distinguish between expenditure which gave pleasure and expenditure which at highest avoided pain. If that were done one began to see some reason for fiscal statistics. As the author had pointed out, originally the function of the State was at highest that of keeping off the evil of war—or of theft—and for keeping off an evil people in general had to be compelled to pay. Few people ever went out and bought an umbrella except under the compulsion of a rainy day. They had to organize themselves through the State to submit to these expenditures which arose out of the lamentable fact of human wickedness. Expenditures of that sort were quite different from the activities of the State in other fields. On the question of expenditure for family allowances, no one would regard children either as a product of human wickedness or as a necessary evil. Fiscal statistics might be separated into those concerned with dodging the result of human wickedness and those concerned with the expenditure of money on objects on which the general public would desire to see it expended. The more the expenditure occasioned by dodging human wickedness grew, the more—it was to be hoped—would an endeavour be made to stop such wickedness. It would be difficult, of course, to say whether provision for unemployment was a necessary evil or a provision necessary for the proper functioning of the State.

He wished to add his thanks to Mr. Schwartz for his stimulating and entertaining Paper. He had shown them that it was essential to look away from the mere channels of expenditure, whether State or personal, to the objects of expenditure. That was the important thing. Another lesson was that in so far as one looked at the channels the only question to ask was whether the method of expenditure was reasonably efficient or not, that is to say, whether the money was most efficiently spent when passed through the State channel or through the private channel.

MR. GAMPPELL said : *Qui judicatis terram diligite justitiam*—but those of them who had to tell the world must evidently watch their step. When the last Budget raised the tax on 1s. worth of tobacco from 19s. 6d. to 29s. 6d., and when a House of Commons, mostly smokers, cheered that and every other tax increase, he had felt justified, as City Editor of Reuters, in informing the universe that this was, so far as it went, an unprecedented burden for free men to impose upon themselves. As himself an inveterate smoker who nevertheless criticized Mr. Schwartz's paper only because it did not go nearly far enough, he felt with the faith-healer of Deal, who said, "Although pain isn't real, if I sit on a pin and it punctures my skin, I dislike what I fancy I feel."

The references to the wheat levy should be in the past tense. It was not being collected at present, as the subsidy was now given in a different form. That this levy was, in fact, taxation collected by the Treasury from a private address, had been adumbrated in various places for about nine years and had sunk well into public opinion, if the concept of public opinion had any validity.

So much so that the millers had represented to the Chancellor that they were now perforce in the tax-collecting business, and as that was not costless, they should be allowed to pay over a little less than they collected on each sack. The Chancellor, however, had thought differently.

As to whether the net revenue of the Unemployment Fund was an insidious form of disguised taxation, he gathered that when Germany did it it was, and when we did it it wasn't. Seriously, however, that portion of it which came directly or indirectly from the workers seemed self-evidently not a tax, but a compulsory savings scheme for the working class as a whole, the first in the country, analogous to the post-war credit portion of the income tax (though the Treasury, strangely enough, included that among tax revenue and not among loans). These unemployment contributions were an accepted and painless method of mopping up purchasing power at source. He had been rather surprised, in reading the recent report of the Unemployment Insurance Fund, not to see the point made that if these net contributions were reduced they would have to be replaced by some other and perhaps less palatable anti-inflationary device. How did the Chairman put a burden on the working-classes when he collected their money at a time when it was unspendable and held it for them against the day when it could be spent and would be needed?

The answer to Mr. Balogh's question as to where we went from here was surely that we went to Russia, where 100 per cent. of the national income was redistributed by the State. In total war, was anything less than 100 per cent. realistic?

As to what one got for the war expenditure, he had always understood that such expenditures were a premium, the portion of one's income which one sacrificed in order to insure the remainder. But our present case went far beyond that, for we were fighting not a war, but a crusade. What we were buying was liberty and the opportunity to build the New Jerusalem. Those were *goods*—not the mere averting of evil but positive and precious goods. Even umbrellas were goods; but we were buying no mere umbrella—we had passed out of the sign of the umbrella in May, 1940. We were bidding for the most glorious opportunity, the biggest bargain in the history of man. Who dared say that it was not worth money? At what price, not merely of money but of life, was it too dear?

The following contributions were received in writing from Fellows who were unable to attend the meeting:

**MR. LEAK :** Mr. Schwartz has provided us with an interesting paper, which may perhaps be described not unjustly as destructive rather than constructive. The purpose of the paper, as I see it, is to show that the normal concept of the burden of taxation is wrong, and that the only real burden is that borne by the community in producing lethal weapons.

Assuming that there is no increase or decrease in overseas capital resources (for which the Government may or may not be responsible), the financial operations of the State, if the income and expenditure sides are balanced, result in a redistribution of income within the country, the Civil Servant taking his share, not, I think, an unduly large one notwithstanding popular belief to the contrary. One person pays out more than he received in benefits and another receives more than he pays. In the aggregate, payments and receipts of the mass of individuals balance, but I must join issue with Mr. Schwartz when he suggests that the concept of burden is meaningless for the individual. It may not be easy of precise measurement, but Mr. Schwartz would, I imagine, hardly suggest that the burden of taxation on a single man having an investment income of £5,000 a year is similar to that of a single man earning £3 a week, or even that the burden was identical for persons with identical incomes, but one earned and the other derived from investments. I think there is a good deal to be said in favour of the table reproduced on p. 98 from the Colwyn Committee Report, though it needs to be supplemented by an assessment of benefits before it can be

used as more than an illustration of the effect of direct taxation and the more important forms of indirect taxation at different income levels. The table at the date to which it relates—1925-6—seems to me to be substantially accurate, as it is only of recent years, essentially following the introduction of the general tariff, that the various subsidies and such like to which Mr. Schwartz refers have become of real importance.

The Post Office accounts, which are the first specifically mentioned in the paper, are an example of State trading, which has received such a tremendous extension during the war. The oversea purchases of food and raw materials are now almost entirely in the hands of the Government, and internally the Government, for example, now pays the railway a fixed sum for their services. We have, in fact, advanced a long way during this war, as we did during the last, towards the complete monopolistic position exemplified by Russia. The trading services, about which we shall doubtless be allowed to know much more after the war than can now be published, deserve special treatment in the Government accounts. They can clearly not be treated as entirely above the line, and they should be regarded as mainly self-balancing items, resulting in either a subsidy to the consumer at the expense of the taxpayer or vice versa.

A distinction can be made between taxes expended on communal services and monopolistic revenue resulting in private profit. Examples of the latter class are the wheat and sugar-beet subsidies, which are paid from indirect and direct taxation respectively; in each case the consumer loses and the producer gains. Looked at in another way, the sugar-beet subsidy should be regarded as similar to expenditure on armaments. They are both a peace-time insurance against deficiency in time of war, so possibly, if Mr. Schwartz is looking for a concept of the burden of taxation in terms only of war, he ought to add to armaments the cost of any payment overseas resulting from war, such as the depletion of oversea assets or incurrence of debt, coupled with what he suggests, viz. any indemnity to a foreign country or service of interest on non-productive debt. I am not certain that any depletion of the national wealth by an adverse balance of payments on current account should not properly be taken into account rather than its war component.

Mr. Schwartz does not suggest any basis for international comparisons unless it be the amount spent on armaments. This would certainly be one basis, but unless the expenditure on the armed forces as well as on armaments were included, I am afraid that the information available would be insufficient to enable any comparisons to be made, and would such inclusion be correct? In any event, what reliance could be placed upon the statistics in a number of countries for the period preceding the war? If the rather wider suggestion I have made should be adopted, how would it be possible to compile statistics for a country such as Russia, where the inhabitants have a lower standard of living than if the resources of the country had not been devoted (*a*) to purchases by the State from abroad of which an indefinite amount was for war purposes and (*b*) to the production of war material within the country?

DR. C. O. GEORGE: I regret I am unable to be present personally to congratulate Mr. Schwartz on the lightness of his touch in dealing with such a subject and on the light he throws into what he at least regards as the shadier corners of public finance. He rightly points out the difficulties of interpreting financial statistics, but is he justified in suggesting that they cannot be prepared with any reasonable degree of accuracy or that, if prepared, they are meaningless? Difficulty of interpretation and preparation and popular failure to understand underlying truths are not peculiar to financial statistics. Others have complained, for example, of the difficulties of comparing the finances of a unitary State with those of, say, a country where one may have Federal and State, County and other widely varying types of local taxation, and, it should be added, expenditure, but one may wonder whether these and similar difficulties have not been much exaggerated.

But I have little complaint to make concerning his attitude to the conception

of a national burden of taxation, for in a recent Paper I ventured to suggest that in a sovereign democracy such a concept can have little meaning, and in any case means little or nothing unless account is taken of the benefits of expenditure. An example of this may be found in the changes in public finance during the last two decades in Russia, where it was claimed before war broke out that 99 per cent. of the national income passed through the Budget. Such an increasing budgetary share of the national income is obviously a necessary concomitant of war where the State does not already control all or most of the national income, but it is interesting to note that this is not the only similarity Russian peace-time finance shows to British finance in war.

Mr. Schwartz emphasizes what the economists have denounced as the humbug of finance—the confusion between the real and the monetary. But are the economists merely exchanging one confusion for another? Are, for example, the goods and services one may have to dispense with owing to tax demands or investments in war loan, a necessarily true or complete measure of the “real” sense of burden experienced by the persons concerned? The economists say such goods or services are a “real” measure, and go on from this to argue that the “real” burden of war finance cannot be transferred to the future. One wonders if Mr. Schwartz would similarly argue that the “real” burden is the same whether one invests £10,000 in debentures or one gives up a similar sum in response to the persuasions of a gunman. As for his examples of the free supply of cosmetics and of the husband who willingly writes cheques amounting to £100 in a year but strongly objects to paying a fixed dress allowance of £2 weekly (which incidentally costs £4 more a year), one could more easily forgive a young and single man for suggesting that the one and only essential fact to be considered is the amount of “real” resources involved.

Elsewhere the author bemoans the fact that the taxpayer is not a perfect specimen of the economic man. But no system of public finance is fully explainable in terms of either the economic man or of “real” resources. Man is full of prejudices and prepossessions. In war-time the statesman, whether or not deploring them, must take full account of these weaknesses if he is to achieve that all-important aim—the maximization of the national potential for war. In peace-time the statesman, or shall we say the politician, may adopt methods of taxation which make its measurement more difficult. But while it may be futile to talk of national tax burdens, it is an entirely different matter to attempt to measure the amounts of taxation paid by different taxpayers or different classes of taxpayers, particularly if an attempt is made to assess the corresponding beneficial payments of public money. Such measurements may have considerable practical and theoretical value. If they are to be reasonably precise and substantially sound, they may present difficulties, but, given time and knowledge of the data, these difficulties should not be insuperable to any competent statistician.

DR. H. W. ROBINSON: The Society has been very fortunate to hear, in less than a year, two very penetrating papers examining, the one partly and the other wholly, fundamental conceptions and assumptions of the theory of Public Finance. The first, by Dr. George, called in question that pillar of tax theory the representative man's curve of utility; and, today, Mr. Schwartz has called in question the very concept of a burden of taxation in any shape or form, thus obliterating at one blow the many imposing edifices built thereon. It would seem that a general review of the basic conceptions and definitions is the first vital necessity of the day, and these interesting and provoking papers might well clear the way, through their critical examination, for a more enduring theory of Public Finance based on more solid foundations.

Mr. Schwartz does not seem to challenge so much the concept of a “burden” of taxation as the concept of “taxation” itself. He points out, rightly, that outside the orthodox published accounts lie many concealed levies on the inhabitants of a country, giving examples from marketing schemes to State-conferred monopolies. But need he stop short at this point? Is a levy, say by one of the great monopolies, not a tax so long as the monopoly receives no

blessing from the State but a tax as soon as the State confers on it the monopoly power it has already won? Clearly, from the point of view of "burdens" and "incidence" such a distinction could be of merely academic interest. "Taxation" must include all such levies arising as a result of the existence of imperfect markets. These might be classified as "Private" taxes as opposed to "Public" taxes, and will be found to occur in almost every branch of economic activity. Private taxes are paid to doctors, lawyers, trade unions, public utility undertakings and a host of other monopolists and semi-monopolists. We have only to realise this to see that Mr. Schwartz's conclusion that it is impossible to measure the "burden" of taxation arises from the impossibility of measuring taxation itself under this wide definition. The problem seems to resolve itself into the search for a definition of "Taxation" which has a significant meaning and yet is capable of measurement.

Turning to other conclusions of Mr. Schwartz's paper, one wonders at times whether he argues that because something is impossible to measure statistically the very concept is meaningless. Take his conclusion that the concept of a burden is meaningless for the individual. Following his line of reasoning the concept presents little difficulty. The burden is simply the difference between what the real income of the individual would be if there were no imperfect markets or taxing bodies such as the State and local authorities, and what his real income actually is. The difficulty arises in measuring this difference statistically. One would need to estimate for the individual the net gain or loss to him of each and every interference by the State, and of each and every imperfect market. Thus one would have to measure the gains from subsidized travel facilities, unemployment benefit, housing, libraries, swimming baths, etc. And all would agree that this is impossible. The only possibility, and one that deserves exploration, is that the order of magnitude of the net gain or loss through taxation, in its widest sense, might be estimated for broad income groups. It might be found possible to neglect, for all but the very lowest income groups, many of the private taxes without affecting the result appreciably.

The concept of a burden for the collectivity would seem to be meaningless always. For it might justifiably be argued that State taxation leaves the country better off than if the taxation had not been imposed. Disregarding all transfers of income between individuals the only conceivable burden for the collectivity would appear to be the burden of waging a war, or, as no doubt Mr. Schwartz would admit, the burden of maintaining a large number of unemployed persons in times of depression. But one must remember that there are certain gains which far outweigh the losses, even if only in the "collective" mind. Few would deny that the resources and labour abstracted from peace-time employments and devoted to the "useless" munitions industries and the armed forces are employed to far greater advantage in continuing the war, since they avoid our surrendering to the enemy and yielding to his economic demands. Similarly the loss of the labour of the unemployed is more than counterbalanced by the gain from the avoidance of social conflict or, perhaps, civil war which might arise if the unemployed were not maintained. Certain collective benefits must be assumed to outweigh the collective cost.

In conclusion may I say how valuable I consider this contribution to be for the theory of Public Finance, and that I trust Mr. Schwartz will take as a compliment to the stimulating qualities of his paper what are intended to be constructive comments and criticisms.

Mr. J. E. ALLEN: No Chartered Accountant would pass the balance sheet submitted to the House of Commons by the Chancellor of the Exchequer. This I take to be the gist of Mr. Schwartz's argument. I agree. May I add some further anomalies to those exposed by him?

In his statement of Revenue the Chancellor reckons the new amounts to be obtained from taxpayers through the lowering of the exemptions and allowances. But he has undertaken that these shall be credited to the taxpayer in the Post Office Savings Bank, *i.e.*, they are Forced Loans, not Revenue.

Again, one-fifth of the 100 per cent. Excess Profits Tax is also to be given back after the War; yet this is reckoned as Revenue, although it is clearly another Loan.

I do not know whether accrued interest on Savings Certificates is included in Expenditure; it used not to be.

Part of the yield of Income Tax is illusory. The rate is now so high that it is taken into account in fixing salaries, also perhaps in fixing wages. Thus it has become in part an Indirect Tax, being passed on to the employer. And the Government is now by far the largest employer. So the amounts appear on both sides of the Chancellor's balance sheet, swelling the proportion called "Revenue."

Wages and earnings have risen so widely that there are few working-class families who have not more money to spend, after allowing for all war taxation, than they had in 1938-39.

Perhaps the Chancellor acts on a maxim attributed by Tacitus to Sejanus: *Non aliter rationem imperi constare quam si uni reddatur.*

MR. SCHWARTZ, in reply, said he would deal with the criticism and suggestions by recapitulating his argument. First of all he had tried to demonstrate, to the satisfaction he believed of most people present, that the official figures gave an incomplete picture of the scope of taxation. He conceded Mr. Hawtrey's point that the Exchequer returns were simply accounts and did not pretend to represent complete statistics. Nevertheless these accounts were used by the Treasury as the basis for the sort of Parliamentary reply which he had quoted in his paper, and to that extent the authorities were responsible for popular views on comparative burdens of taxation, and similar preoccupations. With regard to the problem of defining the scope of taxation, and of supplementing and refining official information so as to cover the whole field he was afraid he was defeatist in this matter. He did not think it could be done. The account given by Professor Shirras of the work of his Enquiry was a confession of this, and the impracticability of achieving a complete measurement for one country ruled out *a fortiori* any international comparisons of respective burdens of taxation.

Where taxation began and ended in a modern community was a fascinating subject for theoretical speculation. Dr. Robinson had put the point very well when he asked, was a levy imposed by one of the great monopolies not a tax as long as the monopoly received no blessing from the State but a tax as soon as the State conferred on it the monopoly power it already had. The State might have unwittingly facilitated the growth of monopoly by the legislative framework which it had established for the market—the company and patent laws, for example, deserved examination from this point of view. Mr. Balogh had asked whether everything must be regarded as a burden which modified the distribution of income as it would come about as a result of a perfectly working free competitive system. Without subscribing to the notion and terminology of "burden" he (the speaker) was happy to throw this thesis back into the pool of discussion. What he had pointed out was that in the matter of taxation that crafty and insidious animal, the politician, had discovered that there were more ways of killing the pig, or rather milking the cow, than one; and that recent years had seen a multiplication of the devices for securing ends which could have been achieved by straightforward taxation, that is taxation in the language understood of the people. One might or might not deplore the success of these devices—Dr. George seemed to think that they took happy and legitimate advantage of human irrationality—but one was surely entitled to point out how the citizenry deluded themselves or were being deluded.

The second point in the argument was that even if the scope of taxation could be defined and measurement taken, the concept of burden was highly dubious and the use of the term an abuse of etymology. There seemed to be general agreement in the discussion that when the benefits of the expenditure were taken into account there was no meaning in ordinary times to the concept of a burden on the collectivity, but some speakers thought that the concept did apply when



individual taxpayers or classes of taxpayers were under consideration. But the effects of State expenditure must be considered in two ways. First there was what might be called the direct effect—the benefits accruing from the goods and services furnished through the medium of State expenditure. Secondly there were the indirect effects on individual earning capacity arising from the new setting given to the system by the action of the State. A millionaire would get no direct benefit from old age pensions, but a man might be made a millionaire by them. As Mr. Paish had pointed out £94,000 might be a cheap price to pay if the income of £100,000 was almost wholly created by State expenditure. It might be patent after the war that taxation was higher on all classes of income in this country as compared with the U.S.A.; nevertheless it might pay a citizen of the U.S.A. to come over here because the form taken by State expenditure here would enable him to obtain a higher net real income than at home. The President had referred to the current controversy about family allowances. The £125 mn. mooted as the cost would not break the back of the collective camel. That seemed to be agreed. The problem was merely political and revolved around the popular decision whether other people's children were little brats or little darlings. If the polling took place when they were asleep he himself would probably vote in favour of the allowances. How the individual taxpayer would emerge as a result of the direct and indirect effects of the expenditure no one could say in advance and probably no one could detect a few years after. A steel manufacturer was not likely to lose from an enhanced demand for fairy cycles, and a childless confectioner who cursed the extra 6d. in the £ might be looking a gift horse in the mouth. He himself would impartially advise the parents to apply the allowances to endowment policies for the subsequent University education of the children.

On the problem of the burden imposed by war he thought they ought to eschew all metaphysics and take grateful advantage of the simple formula laid down by the eminent German who first postulated "Guns or Butter". All that is guns is not butter, and we simply had to decide what is guns. If, with Dr. Stern and Mr. Gampell, we talked of guns as a source of satisfaction, and of buying security, liberty and a New Jerusalem, we approached the point when Hitler became a positive benefactor to mankind because of the satisfaction it would get in suppressing him. It was a lunatic who hit himself on the head because it was so nice when he left off, and a very perverse philosopher who wore tight boots all day because of the immense relief when he took them off at night. The butter and the butter factories which would have been produced in the absence of evil men represented the real cost of their machinations. This cost or sacrifice, he insisted, could not be simply deduced by abstract from the Finance Accounts. It had been suggested that the final adjustment of the Lease-Lend arrangements should be based on the principle of equal proportionate sacrifice by the nations involved. Government expenditure (as shown in the Budget) over national income did not give that proportion, although such calculations were already being bandied about. If the U.S.A. gave its troops more pocket money to spend on creature comforts than did our own Government, that did not increase the burden in the former country. He hoped our authorities had a more sophisticated approach to this problem.

As a result of the ballot taken during the Meeting, the six candidates named below were elected Fellows of the Society:—

John Henry Kirk.  
Arthur Seldon.  
Leonard Charles Worrall.

*Corporate Representatives.*

F. A. Burchardt, *representing* the Oxford Institute of Statistics.  
Thomas Rayner Dawson, *representing* the Research Association of British Rubber Manufacturers.  
Helen Grace Liddell, *representing* the Royal Institute of International Affairs.

## MISCELLANEA

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ON THE DISTRIBUTION OF A WEIGHTED ESTIMATE OF VARIANCE AND ON  
ANALYSIS OF VARIANCE IN CERTAIN CASES OF UNEQUAL WEIGHTING.

By J. O. IRWIN, Sc.D., D.Sc.

LET  $x_i$  ( $i = 1, 2, \dots, n$ ) be a set of variates which are normally and independently distributed with variances  $1/w_i$ , and let  $\bar{x} = \frac{\sum_{j=1}^n w_j x_j}{\sum_{j=1}^n w_j}$  be their weighted mean. It is well known and of frequent application that the quantity  $\sum_{j=1}^n w_j (x_j - \bar{x})^2$  is distributed as  $\chi^2$  with  $(n - 1)$  degrees of freedom, but there does not seem to be an explicit proof in the literature. The following derivation is interesting. Consider the matrix  $L = [l_{ij}]$  where

$$\begin{aligned}
 l_{1j} &= \sqrt{(w_j/\Sigma w)} & j &= 1, 2, \dots, n \\
 l_{ij} &= \sqrt{\left\{ w_i w_j \left( \sum_{t=1}^{i-1} w_t \right) \left( \sum_{t=1}^i w_t \right) \right\}} & \begin{matrix} i &= 2, 3, \dots, n \\ j &= 1, 2, 3, \dots, i-1 \end{matrix} \\
 l_{ij} &= - \frac{\sum_{t=1}^{i-1} w_t}{\sum_{t=1}^i w_t} \sqrt{\left\{ \left( \sum_{t=1}^{i-1} w_t \right) \left( \sum_{t=1}^i w_t \right) \right\}} & \begin{matrix} i &= 2, 3, \dots, n \\ j &= i \end{matrix} \\
 l_{ij} &= 0 & \begin{matrix} i &= 2, 3, \dots, n \\ j &= i+1, i+2, \dots, n \end{matrix}
 \end{aligned} \quad (1)$$

It is easy to show that

$$\begin{aligned}
 \sum_{j=1}^n l_{ij}^2 &= 1 & i &= 1, 2, \dots, n \\
 \sum_{j=1}^n l_{ij} l_{i'j} &= 0 & i, i' &= 1, 2, \dots, n \quad i \neq i'
 \end{aligned} \quad (2)$$

or that the matrix  $L$  is orthogonal.

Now the variates  $X_i = \sqrt{(w_i)} x_i$   $i = 1, 2, \dots, n$  are normally and independently distributed with unit variances, hence, since  $L$  is orthogonal,  $u_i = \sum_{j=1}^n l_{ij} X_j$  ( $i = 1, 2, \dots, n$ ) are also so distributed, and

$$\sum_{i=1}^n u_i^2 = \sum_{j=1}^n X_j^2 = \sum_{j=1}^n w_j x_j^2 \quad (3)$$

is distributed as  $\chi^2$  with  $n$  degrees of freedom.

But

$$u_1 = \sum_{j=1}^n w_j x_j / \sqrt{(\Sigma w)}$$

is normally distributed with unit variance independently of  $u_2, u_3, \dots, u_n$ .

$$\begin{aligned} \text{Hence} \quad \sum_{i=2}^n u_i^2 &= \sum_{j=1}^n w_j x_j^2 - \left( \sum_{j=1}^n w_j x_j \right)^2 / \Sigma w \\ &= \sum_{j=1}^n w_j (x_j - \bar{x})^2 \quad \dots \quad (4) \end{aligned}$$

is distributed as  $\chi^2$  with  $(n - 1)$  degrees of freedom.

When all the  $w$ 's are equal to  $1/\sqrt{(n)}$  the matrix  $L$  reduces to

$$\begin{bmatrix} \frac{1}{\sqrt{(n)}} & \frac{1}{\sqrt{(n)}} & \dots & \dots & \frac{1}{\sqrt{(n)}} & \frac{1}{\sqrt{(n)}} \\ \frac{1}{\sqrt{(2)}} & \frac{-1}{\sqrt{(2)}} & 0 & \dots & 0 & 0 \\ \frac{1}{\sqrt{(6)}} & \frac{1}{\sqrt{(6)}} & \frac{-2}{\sqrt{(6)}} & \dots & 0 & 0 \\ \frac{1}{\sqrt{(12)}} & \frac{1}{\sqrt{(12)}} & \frac{1}{\sqrt{(12)}} & \frac{-3}{\sqrt{(12)}} & 0 & 0 \\ \dots & \dots & \dots & \dots & \dots & \dots \\ \frac{1}{\sqrt{\{n(n-1)\}}} & \frac{1}{\sqrt{\{n(n-1)\}}} & \dots & \dots & \frac{1}{\sqrt{\{n(n-1)\}}} & \frac{-(n-1)}{\sqrt{\{n(n-1)\}}} \end{bmatrix} \quad (5)$$

whose orthogonal property is well known.

For the case of 4 variates, the matrix (1) may be written as in Table I, which brings out clearly the rule of formation of the successive elements.

Further  $\sum_{j=1}^n w_j (x_j - \bar{x})^2$  may be written

$$\begin{aligned} & \frac{w_1 w_2}{w_1 + w_2} (x_1 - x_2)^2 + \frac{(w_1 + w_2) w_3}{w_1 + w_2 + w_3} \left\{ \frac{w_1 x_1 + w_2 x_2}{w_1 + w_2} - x_3 \right\}^2 \\ & + \frac{(w_1 + w_2 + w_3) w_4}{w_1 + w_2 + w_3 + w_4} \left\{ \frac{w_1 x_1 + w_2 x_2 + w_3 x_3}{w_1 + w_2 + w_3} - x_4 \right\}^2 \\ & + \dots \dots \dots \\ & + \frac{(w_1 + w_2 + \dots + w_{n-1}) w_n}{(w_1 + w_2 + \dots + w_n)} \left\{ \frac{w_1 x_1 + w_2 x_2 + \dots + w_{n-1} x_{n-1}}{w_1 + w_2 + \dots + w_{n-1}} - x_n \right\}^2 \quad (6) \end{aligned}$$

in which each term is the square of the difference between a weighted mean and a single observation, divided by its variance. This shows that the  $(n - 1)$  degrees of freedom may be resolved into  $(n - 1)$  independent comparisons between the first two variates, between the third and the weighted mean of the first two, between the fourth and the weighted mean of the preceding three and so on.

This result may be utilised to apply analysis of variance methods to certain cases of unequal numbers or unequal weights.

For example 11 different determinations of the median fertility dose of a preparation of Vitamin E (see *Nature*, Oct. 18th, 1941) gave the results shown on p. 118.

TABLE I.

$\sqrt{\left\{\frac{w_1}{\Sigma w}\right\}}$	$\sqrt{\left\{\frac{w_2}{\Sigma w}\right\}}$	$\sqrt{\left\{\frac{w_3}{\Sigma w}\right\}}$	$\sqrt{\left\{\frac{w_4}{\Sigma w}\right\}}$
$\sqrt{\left\{\frac{w_2 w_1}{w_1(w_1 + w_2)}\right\}}$	$\frac{-w_1}{\sqrt{\{w_1(w_1 + w_2)\}}}$	0	0
$\sqrt{\left\{\frac{w_3 w_1}{(w_1 + w_2)(w_1 + w_2 + w_3)}\right\}}$	$\sqrt{\left\{\frac{w_3 w_2}{(w_1 + w_2)(w_1 + w_2 + w_3)}\right\}}$	$\frac{-(w_1 + w_2)}{\sqrt{\{(w_1 + w_2)(w_1 + w_2 + w_3)\}}}$	0
$\sqrt{\left\{\frac{w_4 w_1}{(w_1 + w_2 + w_3)\Sigma w}\right\}}$	$\sqrt{\left\{\frac{w_4 w_2}{(w_1 + w_2 + w_3)\Sigma w}\right\}}$	$\sqrt{\left\{\frac{w_4 w_3}{(w_1 + w_2 + w_3)\Sigma w}\right\}}$	$\frac{-(w_1 + w_2 + w_3)}{\sqrt{\{(w_1 + w_2 + w_3)\Sigma w\}}}$

1 + log M.F.D. (mgm.)	Weight	Method of administration of doses
0.7384	498	DE
0.8224	185	"
0.8184	718	"
0.8581	70	"
0.9265	812	"
1.0543	1258	"
1.0559	499	"
1.1748	820	"
1.2319	711	"
0.7475	876	DL
1.1327	1007	SE

Weighted mean  
= 1.0074 with  
weight 5571

D = divided, E = early, S = single, L = late.

The median fertility dose was determined from the responses of groups of female rats to 4 graduated doses of the vitamin, the response being the percentage of positively mated female rats which produced a litter. The weights are the reciprocals of the error variances of the determinations. Doses were as a rule given in equal amounts spread over the first five days after positive mating (*divided doses*), but one laboratory gave the whole dose as a *single* dose on the fourth day after positive mating. One laboratory gave the divided doses *late*, the dose being spread over five days, beginning on the fifth morning counting from and including the morning on which positive mating had been established.

The weighted sum of squares of the deviations of the 11 determinations from their weighted mean is 211.24, and the effect of method of administration of dose can be examined, utilising (6) by an analysis of variance as follows:—

	Sin of squares	Degrees of freedom	Mean square	Variance ratio
Between different method of ad- ministration	DE v DL ... S v D ...	1 } 2 1 }	51.13 } 22.47 } 36.80	2.97 } 1.31 } 2.14
Between determinations by the same method ...	137.64	8	17.21	—
Total ...	211.24	10	—	—

5% values of variance ratio : { 5.32 for 1 and 8 DF.  
4.46 for 2 and 8 DF.

Here the 3 degrees of freedom for methods of administration have been subdivided into a comparison of "divided early" against "divided late" and of "single against divided" (early or late). Neither effect is significant; had DE v DL been significant, it would have been advisable to compare SE with DE separately.

## NOTE ON THE ESTIMATION OF A RANKING

By M. G. KENDALL

1. SUPPOSE a number  $m$  of observers rank a number  $n$  of objects in given orders—*e.g.*, with three observers and eight objects the ranking might be

Object	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	A <sub>4</sub>	A <sub>5</sub>	A <sub>6</sub>	A <sub>7</sub>	A <sub>8</sub>
Observer 1	4	2	1	7	6	3	5	8
Observer 2	7	2	1	6	4	5	3	8
Observer 3	7	4	2	6	5	3	1	8
Sum of ranks	18	8	4	19	15	11	9	24

(1)

2. From the work of Friedman (1937, 1940) and Babington Smith and myself (1939) it is possible to measure the concordance between the rankings and to test its significance. The problem then arises: if there is a significant concordance, to find the ranking of the objects on which there is the greatest measure of agreement. If the observers are reliable judges this amounts to estimating the true ranking of the objects.

3. One possibility which suggests itself is to rank the individuals according to the number of "firsts," "seconds," etc., which are allocated to them by the different observers. Thus, in the example above, object A<sub>3</sub> has two "firsts," and we rank it as 1; object A<sub>7</sub> has one "first," and we rank it as 2; and this exhausts the "firsts." Looking then to the "seconds," we see that A<sub>2</sub> has two, and so we rank it as 3. The other "second" has occurred under A<sub>3</sub>, which has already been ranked, so we proceed to the "thirds"; and so on. The ranking obtained in this way is

$$A_3 A_7 A_2 A_6 A_5 A_1 A_4 A_8 \dots \dots \dots (2)$$

When we consider the "fourths" there are two members, A<sub>5</sub> and A<sub>1</sub>, having one each. The former, however, has a "fifth," whereas the latter has only two "sevenths," so A<sub>5</sub> takes precedence. An essential ambiguity may arise if any two or more individuals have exactly the same set of ranks.

This procedure, whatever may be its value in giving credits in examinations, is unsatisfactory as a method of estimation. In fact, it is not self-consistent. Suppose we start from the other end of the ranking and rank as 8 the individual with the greatest number of "eighths," and so on. Then in example (1) we get

$$A_3 A_2 A_7 A_6 A_5 A_4 A_1 A_8 \dots \dots \dots (3)$$

which is not the same as in (2). Now, in general, there is no reason to start ranking from one end rather than from the other. For instance, if observers are performing a colour test by arranging coloured discs in a range from blue to green, there is no reason why one end of the spectrum should be regarded as having precedence over the other. It is evidently unsatisfactory that the two procedures should give different answers, and on this ground alone the method of counting place-marks is to be discarded.

4. A second possibility is to rank according to the sums of ranks allotted by the observers. These sums are shown in (1), and we should rank as 1 the



Consequently the average Spearman correlation between the estimated ranking and the observed rankings is

$$\begin{aligned}\frac{1}{m} \sum_{k=1}^m P_k &= \frac{12}{m(n^3 - n)} \sum_{k=1}^m \sum_{j=1}^n \left( X_j - \frac{n+1}{2} \right) \left( Y_{jk} - \frac{n+1}{2} \right) \\ &= \frac{12}{m(n^3 - n)} \sum_{j=1}^n \left( X_j - \frac{n+1}{2} \right) \left( S_j - \frac{m(n+1)}{2} \right) \\ &= \frac{12}{m(n^3 - n)} \left\{ \sum (XS) - \frac{mn(n+1)^2}{4} \right\}\end{aligned}$$

Thus, if  $\sum(SX)$  is a maximum, the average Spearman correlation between observed and estimated rankings is also a maximum, and from this point of view also the method of estimation is the best.

#### References

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 Kendall, M. G., and Babington Smith, B., "The problem of  $m$  rankings," *Ann. Math. Statist.*, 1939, **10**, 275.



## THE PRESENT POSITION OF WOMEN IN INDUSTRY \*

By CLARA E. COLLET

It is exactly seventy years since the perfect rapture of expectation was surpassed by the rapture of fulfilment at the Drury Lane Theatre; and my first memory of the separate existence of my brothers is my surprise at their enjoyment of the clowning which came like a douche of cold water on my ecstasy after the ballet and transformation scene.

Another vivid memory is dated six years later, when "Bob Lowe," the *enfant terrible* of the government, had proposed the match tax, the motto "*ex luce lucellum*" to be inscribed on the label. Bryant and May's match-girls had gone in procession to Westminster (so I was told), and the newspapers that morning announced the withdrawal of the tax. Our nursemaid, and I, on one side of a hedge, engaged in conversation with a field labourer on the other side, who explained to me how the rich ground down the poor and handed me a hot baked potato from his lunch. In those days fires, candles and gas-jets consumed an enormous number of matches, and the tax would have fallen heavily on the housewife.

It was a year later that our charwoman's daughter was the centre of a great movement. She was eleven years old, and could do vulgar fractions, and was placed in the top standard of the new Board School. I was the same age, and could also do vulgar fractions, and was well aware that the accomplishment was rather exceptional. We shelled peas together one day, and I mentally paid homage to a superior. Katie Dobbin was to become a pupil teacher at a board school when she was thirteen, with every prospect of becoming a fully-qualified teacher, and perhaps a head-mistress eventually. In those early days of compulsory education competitive examination in the elementary schools was inevitably necessary, in order to discover children intelligent enough to be trained to teach what they were taught until such time as there was a supply of competent young women to teach what they knew. Critical as one may be, and as everyone was at the time, of the kind of teaching available, it would be impossible to over-estimate the effect in the homes of the influence of the wives and mothers of good intelligence who for the first time in our history were able to help their children in their school work. The result was hardly seen in 1906, when a Labour Party took its place in Parliament for the first time, but was conspicuous in 1924.

In those days of the 'sixties and 'seventies it seemed to be an almost everyday item of news that some working woman, kicked nearly to death by her husband, had implored the magistrates on his behalf not to punish him by imprisonment. There were always paragraphs on these fresh instances of women's unconquerable tenderness. The apotheosis of the "doormat" in the Wife, not merely as an ideal to be admired but as a reality to be revered, is the theme of Robert Buchanan's *Vision of the Man Accurst*, published in 1870. In 1870, however, an Act was passed giving married women the legal right to their own earnings as wage workers. This legal emancipation of women was of far greater importance, potentially affecting as it did quite 98 per cent. of married women, than the

\* Read and discussed at the Adam Smith Club, January 12th, 1935, with Dr. James Bonar in the Chair.

Married Women's Property Act of 1882, which (although not retrospective) gave the propertied wife full ownership. But the great majority of wives were illiterate, and it took at least forty years for them and their children to realize their legal status, and they were still not owners of their own persons. If a wife left her husband and earned wages to support herself and children, he could no longer legally draw her wages and pocket her savings, but he had other powers to make her separate existence impossible, and she worked in the labour market at great disadvantage. Many men never knew that they had lost their "right" to their wives' earnings, but many who did felt an increasing reluctance to let them become wage-earners; the wife was to stay at home, and the daughter could go out to work. The father's right to his children's earnings was untouched. Compulsory education and factory and workshop Acts gradually raising the age limit for leaving school and entering wage service, steadily (but very slowly) worked for the protection of the child from 1878 onwards.

Apart from the textile trades, which were mainly carried on in the north of England in factories, the needlework industries were those to which most women turned when the income of husband or father was inadequate and when he himself carried on no craft in which they could assist him at home. The domestic workshop or semi-domestic workshop was widespread in the boot and shoe, hosiery and tailoring trades, with the husband as employer, drawing payment from the giver-out of work, and not responsible for wages to wife or children. Dressmaking was the most skilled and, in the case of efficient women, the most remunerative industry. The mediocre dressmaker or needlewoman had three insuperable obstacles in her attempts to earn a living. Practically all her employers could do the work themselves if the price of it was beyond their means; large numbers of needle-workers entered the market as casual workers for the sake of pocket-money; the customers themselves, for the most part, paid their bills out of small allowances, their pocket money. Every halfpenny to such women had the marginal utility of sixpence to their husbands or fathers.

The sewing-machine was coming into use in these mid-Victorian days, but was rather a blessing in the homes of those who condescended to wear machine-stitched petticoats and nightdresses than to wage-earners, until treadle-work was lightened and sub-division of labour made possible in factories with power-driven machines.

The living-in system, which had prevailed in businesses giving full employment to unmarried women and girls, gradually became hateful to the workers and unprofitable to employers when restrictions on hours of work put an end to their unregulated overtime during the pressure preceding fashionable race-meetings, Court drawing-rooms, weddings, balls, etc.

Now in January 1935, what is the position of women in industry? I include under that term all energies directed to supplying the demand of any market in which exchange of goods takes place. The answer to the question cannot be given without reference to their position in personal service, the term covering those engaged on home duties and in family service; and in establishments carried on for the sake of profit such as schools and nursing homes, or for the public welfare such as asylums, hospitals and other institutions.

Whether gainfully employed in industry or in personal service, there is in the background of the life of most women the predominating influence of the position of men and women in marriage. That position has been vitally affected by laws

prescribing the terms on which marriage must be entered. Few laymen and no women have ever had the opportunity of influencing the marriage contract imposed by law.

The economic emancipation of married women in England dates from 1870; their political emancipation from 1918. Not till 1939 will free-born women voters appear on the register.

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## REVIEWS OF STATISTICAL AND ECONOMIC BOOKS

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1.—*The Analysis of Economic Time Series.* By H. T. Davis. Bloomington, Indiana: Principia Press. 1941.  $9\frac{1}{2}'' \times 6\frac{1}{2}''$ . xiv + 620 pp. \$5.

It was high time that someone wrote a book of this type. The literature of time series has been getting out of control for several years and is difficult to keep track of, partly because of its bulk, and partly because of the many different places in which it appears—the student, for example, is apt to find (or rather, not to find) memoirs of direct economic relevance in journals devoted to parasitology or electro-technology. One of Professor Davis's tasks has been to reduce all this material to some sort of order and to exhibit the inter-relationship of the various techniques of analysis which have grown up. This alone would be a formidable undertaking. Add to it the necessity of illustrating theoretical work at every stage by practical example and the difficulty of preserving a just critical faculty in the middle of highly controversial topics, and one has some idea of the magnitude of the problem confronting the author who sets out to write "a systematic treatise on economic time series." The task, in fact, is almost beyond the powers of an individual, and it is no depreciation of Professor Davis's own accomplishments to observe that to some extent the book is a co-operative effort from the Cowles Commission for Economic Research. The author has been able to draw freely on the assistance of his fellow-members on the Commission's research staff and, what is almost equally important, on the wealth of arithmetical work carried out by the Commission since its foundation.

Broadly speaking, the book falls into two main sections. In the first the author gives an account of the statistical technique of time-series analysis, particularly of the analysis of oscillatory movements. In the second he proceeds from statistics to economics and considers the economic features which can account for the phenomena he has described. The best way of giving a fair idea of the scope of his treatment, perhaps, is to describe the book chapter by chapter.

Professor Davis opens with a chapter entitled "The History of the Problem," in which he surveys the development of theories about the nature of economic time series and the methods of analysis to which they have led. He then proceeds in Chapter 2 to discuss the technique of harmonic analysis, an excellent account in which theory is accompanied at each stage by example. Chapter 3 deals in a similar way with serial correlation analysis, and Chapter 4 with the theory of random series.

Chapter 5 appears to me to fall rather below the level of the others. It is entitled "The degrees of freedom in economic time series," but also contains short accounts of a number of auxiliary topics, such as tests of significance in harmonic analysis, factor analysis as applied to time series, Frisch's confluence analysis and what the author calls "the method of elementary energies." It appears that by degrees of freedom of a time series Professor Davis means the number of parameters in the mathematical expression which represents it. He appreciates, but rather seems to gloss over, the fact that the degrees of freedom will depend on what sort of functions are chosen to represent the series, observing

that in such a case the degrees of freedom will be the smallest number possible *if all types of functional representation were tried*. It is not easy to see what this means, for there is always some function among all possible types, however bizarre, which will exactly represent any series. Nor is the illustration very convincing. By applying his own method to a particular case the author arrives at the conclusion that the degrees of freedom of a certain series number 43. But "the number of degrees of freedom is actually 11 instead of 43 (because the series is the sum of four harmonic terms), but this could not be known without a further study of residuals. Hence the estimate of 43 is not unrealistic." Many of us would consider a method which gave two different answers to the same question, one four times the other, as decidedly unrealistic within any ordinary connotation of the word.

Chapter 6 proceeds to the analysis of trends, and many readers would have expected it to come before the chapters dealing with the analysis of oscillatory movements. However, its position is not an accident, for trend to Professor Davis is "regarded as the residual variation which remains after the harmonic structure has been removed from the data." This definition may startle the orthodox, but it is not so odd as it sounds, for it attempts to circumvent the difficulties associated with the concept and definition of trend which are too often ignored. However, the question whether trend or oscillation is the more fundamental is very much like the question whether the hen came before the egg or vice versa, and Davis's treatment, if it does nothing else, brings this fact forcibly before the reader.

Chapter 7, on periodograms, is exceptionally good, and would alone make this book worth reading. Professor Davis has collected together all the periodograms on economic time series known to him, about 20 in all. Many of them exhibit a peculiar tendency to develop a continuous spectrum for longer trial periods, and throw very serious doubt on the reality of long cycles which are claimed to have been detected in economic series by the periodogram method. In fact one begins to wonder, after looking at the diagrams presented in this chapter, whether periodogram analysis is at all a safe method to employ, even with such tests of significance as are available. Professor Davis is rather cautious on this point, but he seems to have established beyond reasonable doubt his contention that the significance of periods shown by the periodogram should be checked by an estimate of the contribution of the continuous part of the spectrum to the total variance. It rather looks as if the application of the analysis to economic series in the past has been made too lightheartedly. I only wish that Professor Davis would carry out the same service for correlograms as for periodograms, and assemble together all those calculated for economic material. The result might be very illuminating.

Chapter 7 concludes Professor Davis's examination of the techniques of analysis. He then proceeds in Chapter 8 to consider the evidence for and explanation of cycles in economic terms. Chapters 9 and 10 deal with the nature of wealth and income and with the dynamics of trends from the point of view of the equation of exchange. The former in particular appears to me rather intrusive, for it deals mainly with the Pareto distribution of incomes, and is only of tangential relevance to economic time series. The conclusion of the latter is that the equation of exchange "is one of the most powerful and deep-seated propositions for the exploration and interpretation of economic data." Chapter 11 deals with methods of forecasting and emphasizes the wide band of error which attends projection into the future and the consequent limitations on present forecasting methods. Finally, in Chapter 12, Professor Davis reviews his whole subject in a critical way. One may mention one of his suggestions as of general interest. It concerns the relationship of sunspot cycles to terrestrial cycles, a subject which one constantly hears spoken of as dead, but which obstinately refuses to lie down. Referring to the stimulating effect of ultra-violet radiation which produces in extreme cases a sort of light-mania, the author advances the possibility that sunspots known to be associated with

actinic radiation may account for the waves of optimism which precede economic crises. This suggestion will probably not find much favour in the atmosphere of the City of London, but it is one of the many intriguing ideas and scraps of information which are to be found dispersed throughout the book.

This is not a book of which one can write with unrestricted enthusiasm. No mention is made of the theory of relaxed oscillations, which can also explain the shifting phase and varying amplitude characteristic of stationary time series. The account of confluence analysis is either too short or too long. Professor Davis might consider whether his historical introduction could not be knit together and put into proper balance. For example, the account of tulip mania in Holland seems out of perspective, and it is arguable whether the subject is not more a branch of psychology than of economics; and the treatment of the 50-year cycle seems particularly sketchy. One would like to see illustrations of the interesting concept of statistical hysteresis, which is discussed only in general terms; and one would like to know whether the author's method of elementary energies can give anything which is not more simply obtainable by other methods.

But taking it by and large, this book is a notable achievement. It is probably the most comprehensive book on economic time series that has yet been written, and one which every serious student of the subject should read without delay. It provides something which teachers have long been wanting, a conspectus of a difficult and tortuous subject and an unbiased account by a man who thoroughly appreciates that example is better than precept. I hope that Professor Davis will not cease to labour at this book until he has made it a standard work.

M. G. K.

2.—*Guide for Quality Control and Control Chart Method of Analysing Data.* (B.S. 1008:1942.) London: British Standards Institution. 1942. 8½" × 5½". 49 pp. 3s. 6d.

*Quality Control Charts.* By B. P. Dudding and W. J. Jennett. (B.S. 600R:1942.) London: British Standards Institution. 1942. 8½" × 5½". 85 pp. 3s. 6d.

Much has been done recently to make known statistical methods of quality control and to encourage their wider adoption in industry. Although these methods are by no means peculiarly American, most of the work of publicizing them has been done in America, and quite an extensive literature has been produced there. In addition to pamphlets and short articles there are substantial works—W. A. Shewhart's *Economic Control of Quality of Manufactured Product* (1931) and *Statistical Method from the Viewpoint of Quality Control* (1939), and L. E. Simon's *An Engineer's Manual of Statistical Methods* (1941). Much of this writing is of considerable interest, in that it records the author's experience of using the methods and is a profession of his confidence in them. But in other respects it sometimes falls noticeably short of perfection. Mathematical deficiencies are not perhaps very important here, but one notes also a lack of brevity, clarity, and simplicity. Indeed, the second work by Dr. Shewhart mentioned above has an air of deep learning that must have repelled many intending readers, both statisticians and new-comers to the subject. This is a pity, for the main ideas and the operation of quality control are simple, and making them appear complicated is an ineffective way of guarding against misunderstanding. The two publications under review were produced by the British Standards Institution "to meet a pressing demand arising out of war conditions" and they are particularly welcome for the simplicity with which they put their case.

B.S. 1008 consists of a reprint of an American Defence Emergency Standard, together with an appendix taken from the *Manual on Presentation of Data* published by the American Society for Testing Materials. The Standard deals with the main ideas of quality control and with the control-chart technique. It is carefully worded and admirably terse, and forms a satisfactory declaration of principles. The appendix explains in detail how the charts are constructed;

being concerned only with the method and not with general statistical principles, it makes rather arid reading. There is some overlapping between the appendix and the main text, but, on the other hand, a collected set of definitions is not provided. The control limits recommended are of the  $\pm 3\sigma$  type usual in American practice. As they are conventional and fairly insensitive in detecting lack of control, their precise placing cannot matter greatly; nevertheless it should, perhaps, be remarked that the formula given for the standard deviation of an observed standard deviation is only true asymptotically for large samples, and one may note also the odd inconsistency in the methods (root mean square and arithmetic mean) given for pooling observed standard deviations. A short bibliography is included.

B.S. 600R is described as Part I of a revision of B.S. 600 (1935), E. S. Pearson's *The Application of Statistical Methods to Industrial Standardisation and Quality Control*. It does not bear much superficial resemblance to the original; not only is the scope considerably smaller, but the material has been rearranged and rewritten, and some fresh matter has been added; Dr. Pearson's name no longer appears on the title-page. As a whole it is clear and vigorous; though the discussion of generalities is not conspicuously good, as in B.S. 1008, the description of the charts is much fuller, and affords an interesting contrast in methods. The first three sections are introductory, the fourth deals comprehensively with control charts for qualitative data, the fifth and sixth with control charts for quantitative data, and the seventh section is concerned with miscellaneous topics—sampling procedure (including choice of sample size), choice of statistical parameters for charting, and the introduction of a chart system. The appendix includes definitions, tables and figures for constructing control charts, and specimen workings, and also a comparative table of symbols used in B.S. 600R and B.S. 1008; there is no bibliography, but some references to mathematical literature are given in the text. Among points omitted from B.S. 600 in revision the discussion of fiducial limits is notable, while the section on qualitative data is new, and the problem of choice of sample size receives considerably more attention. The writing is occasionally a trifle careless—for example, the insistence in Section 4 on the case where one defective exactly is expected is rather unfortunate. This is no doubt the result of haste, and is but a small blemish in a sound piece of work.

A reading of these little books prompts some reflections on the points of view presented. A perfect state of control of a manufacturing process subsists when, in regard to any observed characteristic, every specimen is an independent member of a single population; in practice we have to decide how nearly we are to attain to this state. And here it is necessary to distinguish clearly between the statistical significance of an observed effect and the practical significance or importance of a possible real effect. One would presumably like to choose sample sizes and the method of analysis so that the smallest departure from uniformity that could matter or be of any interest would probably be detected and appear as statistically significant; but, of course, the more sensitive the testing the greater is the chance of statistically significant effects being produced by unimportant causes.

These are two variables affecting sensitivity: sample size (and frequency of sampling) and the efficiency of the mathematical analysis. The view commonly held is that, for factory use, the analysis should always be as simple as possible; but surely no hard-and-fast rule can be laid down on this point. If sampling were very expensive, say involving the destruction of scarce material, it might well be desirable to use fully efficient statistical tests. As already remarked, the  $\pm 3\sigma$  system of control limits usual in America is of low sensitivity. A good illustration of this is shewn by example B1 in the appendix to B.S. 1008, where a set of ten samples of fifty observations is examined by control charts for heterogeneity in means and dispersions; no lack of control is thereby indicated, but efficient tests reveal highly significant heterogeneity in both the means and the dispersions. The justification given in B.S. 1008 for these wide limits is that

they have been found to strike an economic balance between the need for detecting important effects and the desirability of not detecting unimportant ones. But, to judge from other writers of the American school, a further consideration that has weighed heavily is that of ignorance of distribution shape, and confidence is placed in Tchebycheff's inequality for the area of the tails of a distribution, or at best in a similar but sharper inequality due to B. H. Camp and M. B. Meidell, rather than in the results of normal-law theory. In B.S. 600R, on the other hand, the treatment of quantitative data is based frankly on normal-law theory, general observations merely being made from time to time on what the effect of a departure from normality would be.

B.S. 600R contains a very useful discussion of sensitivity, in which it is shewn how to calculate the chance that points will fall outside the control limits when the population changes. Perhaps it is ungrateful to ask for more, but a comparison of the control-chart techniques with exact methods would have been very welcome, as also would a discussion of how most efficiently to place a single pair of control limits on a chart in order to detect lack of control. The most efficient method to use will depend on the kind of heterogeneity to be detected, and also on its size. For example, three quite different types of heterogeneity are: (1) occasional isolated effects to be observed only in single samples, (2) random (but steady) variability in the populations (batches) sampled, (3) a sudden permanent change or a consistent trend. Each requires different treatment, and in practice we shall generally have to compromise. One may hope that in any future revision these points will receive some mention.

In this connection an assertion is made in the handbook (p. 46) which seems over-bold. Apropos of quantitative sampling: "It will be obvious that increasing the number of sub-groups increases the likelihood of tracing sources of variability. . . . For example, if a testing limit of 30 specimens is imposed it would be preferable to take 5 specimens per sample from each of 6 sub-groups or even 3 specimens from each of 10 sub-groups rather than 15 samples from each of 2 sub-groups." This is a matter for careful investigation, and is far from obvious. A good case can be made for 5 as the optimum number of sub-groups.

F. J. A.

3.—*National Income and its Composition, 1919-1938*. By Simon Kuznets, assisted by Lillian Epstein and Elizabeth Jenks. (Publications of the National Bureau of Economic Research No. 40.) New York: National Bureau of Economic Research. 1941. 9" x 6". 2 vols. xxiv + 929 pp. \$5.00.

Whilst the general "statistical mania" of the Americans has long been a source of quiet amusement to the British, it is equally true that British economists have always envied their American colleagues the multitude of statistics placed at their disposal on all aspects of the economic life of the United States. To take an instance from one particular sphere. After about six months' delay, public companies in Britain normally vouchsafe their shareholders some general information as to their operations in the preceding year. To the economist, this information is usually of limited value. The majority of important American companies, on the other hand, not only produce monthly reports on the volume of their operations, but also quarterly reports on the profitability of these operations.

Apart from the wealth of material available, American economists in recent years have also had the benefit of the efforts made to organize the multiplicity of statistical detail into measurements of those broad magnitudes which form the basis of economic theory (e.g., national income, investment, saving and depreciation). The valuable work of the National Bureau of Economic Research in this most useful sphere of statistical activity has become increasingly well known in this country. These two volumes maintain fully the standard we have come to expect, and will undoubtedly become the standard work on the broad economic trends in the United States during the "between wars" period.

The aim of the investigation, the results of which are set out in these two



volumes, has been to endeavour to reach satisfactory estimates of the national income of the United States for each year since the 1914-18 war. Inevitably, an investigation of this nature has led into such wide issues as the need for an analysis of the longer-term and cyclical fluctuations in the national income and its components, quite apart from the necessity of reviewing afresh the whole problem of its definition and measurement.

The plan of the book is simple. The first part is devoted to a full discussion of the problems involved in defining and measuring national income and in delimiting properly its significant components, and to outlining the bases of the estimates and the limitations arising from incomplete data. Part Two deals with long-term and cyclical fluctuations in the American national income, and its distribution during the period under review. In Part Three there is a full description of the estimates, their derivation and their margins of error, together with a helpful comparison of the Bureau's latest estimates with those of the Department of Commerce and Mr. W. I. King, as well as with the Bureau's own earlier estimates. Part Four presents the details of the estimates both by industrial groups and by types of income, and describes the methods used in deriving the individual estimates and their sources. Part Five assembles conveniently certain supplementary data, such as the payments to company officials, the dividends, interest and taxes paid by companies, their bad debts and the gains and losses arising from their sales of capital assets.

It is impossible, within the scope of a review, to do more than briefly describe a few of the more noteworthy results of the significant and successful investigation undertaken by Mr. Kuznets and his collaborators. Within the more than 200 tables, each suitably indexed and presented with commendable clarity, there is abundant material for all students of secular change in the United States as a whole and in particular industries. The authors have endeavoured, in a praiseworthy manner, to present their data, wherever possible, in such a way as to be of use to other investigators who do not accept their decisions on the highly controversial subject of the proper scope of the definitions of the items which comprise the national income.

The national income concept used by Mr. Kuznets is defined as "the net value of all economic goods produced by the nation," although estimates of aggregate payments to individuals and of consumers' outlay are also given. In other words, the authors have chosen the "market prices" basis (*i.e.*, goods produced valued at market prices) rather than the "factor cost" basis (*i.e.*, the earnings of the factors of production). It will be recalled that the "factor cost" method has been used in this country as the basis of the estimates of national income given in the White Papers issued at Budget time, and has come to be regarded in many quarters as the more useful measuring rod.

In estimating national income, the authors rightly have laid particular stress upon the need for continuing and comparable annual statistics. The value of periodical estimates of national income, frequently at very wide intervals, became increasingly less in the period following the 1914-18 war, when the rate of change in economic activity was accelerated not only in amplitude, but in time. In fact, even annual statistics of the main forces which comprise economic activity are of limited value to students of the trade cycle, since they conceal the immediate circumstances surrounding the turning-point in the cycle. For example, the estimates given by Mr. Kuznets for the years 1937 and 1938 contribute nothing to the study of the fascinating and instructive developments of the business cycle in the United States in those two years.

The majority of the readers of these volumes will find most of what they need in Part Two, where the changes in both the magnitude and distribution of the American national income during 1919-38 are discussed. It is estimated that over the whole period, the annual national income amounted on average to \$66.7 milliards, the range of fluctuation being between \$87.2 milliards in 1929 and \$42.2 milliards in 1933 (for comparison, the present level is believed to be \$95-100 milliards). The corresponding figures for consumers' outlay (*i.e.*,

national income less capital formation) are \$61.9 milliards, \$77.2 milliards and \$45.8 milliards. The authors show the same figures adjusted to take account of variations in prices, the range of fluctuation thereby being appreciably reduced. The estimates are presented also on a per head basis in terms of the entire population, of those gainfully employed, of those actually employed, and finally in terms of equivalent consuming units. It is interesting to note that, taking account of the increase in population, national income was less in the decade 1929-38 than in the decade 1919-28 on each basis except that of persons actually in employment. An indication of the ravages of the Great Depression is to be found in the estimate that over the thirty years 1909-38 the national income per head of population barely increased if at all in the United States.

The changes in the distribution of the national income by industrial groups during the period of 1919-38 are especially instructive. For example, the share of agriculture declined steadily from 16.5 per cent. of the total in 1919 to 8.4 per cent. in 1938, whilst over the same period the service industries expanded their contribution from 9.3 per cent. to 13.7 per cent., and Government services from 5.7 per cent. to 16.7 per cent. Generally speaking, there has been a steady movement away from the commodity-producing industries to the service industries in the United States as in this country.

Equally instructive is a most detailed analysis of the distribution of national income by classes of income recipients. We see labour's share of the total rising from 57.9 per cent. in 1919 to 59.7 per cent. in 1929 and 67.7 per cent. in 1938, at the expense of entrepreneurial savings. Over the entire period the share of the owners of the means of production amounted to less than one-fifth of the total income (rents 6 per cent. of the total, interest 7 per cent. and dividends 6 per cent.). Most striking is the declining share of the national income represented by net savings and their expected wide fluctuations during the course of the business cycle.

In Chapter 7 of Volume I, the authors attempt to estimate how the national income is utilized. They find that, over the whole period, only 6 per cent. of the total went to net capital formation (or net real investment), although in the prosperity years 1924-28 the figure exceeded 10 per cent. The decline in capital formation over the period as a whole is attributed to the enormous construction "boom" in the 'twenties and the failure of the New Deal to bring about any lasting recovery in the building industry. As theory would lead us to expect, net capital formation shows an appreciably wider range of fluctuations than national income.

An analysis of consumers' outlay shows a surprising lack of change over the period in people's desire to spend their incomes on perishable, semi-durable and durable goods respectively, the proportions being almost identical in the decade 1919-28 and in 1929-38. Roughly, it is estimated that American income recipients tend to spend 40 per cent. of their incomes on perishable goods, 15 per cent. on semi-durable goods, 11 per cent. on durable goods and 33 per cent. on non-commodity services.

The remaining chapters of the books are devoted to a description of the data used in compiling the estimates and an appraisal of their omissions and reliability. The main omissions fall into such categories as the imputed income from the services of housewives and other members of the family, and from the use of durable goods other than houses; employees' pensions, workmen's compensation, etc., income from boarders, gardens, back-yard live stock, etc.; casual service income; royalties; bad debts and taxation. The authors guess—and they admit that the margin of error is very wide indeed—that in 1929 these omissions may have amounted to \$33 milliards (say 40 per cent. of the recorded national income for that year), of which the value of housewives' services is put at \$23 milliards on the basis of the average earnings of domestic servants and farm workers.

The authors have given considerable thought to the reliability of their estimates and of the margins of error inherent in their calculations, and have

made a serious attempt to reach a quantitative evaluation of the errors by methods which reflect essentially the personal judgments, intuition and guesswork of the investigators. Their conclusion is a fair statement of the problems which are entailed in all investigations of this kind in the present state of our statistical knowledge of the working of the economic system:

"... by far the major source of error in our estimates is the inadequacies of existing data. The choice is, therefore, not between present estimates and better estimates: it is largely between present estimates, inadequate as they are, worse estimates or no estimates at all. . . . It is thus important to use the data already available, with complete recognition of their faults but without giving way to perfectionist despair. Many of our estimates will prove inadequate in the light of fuller information in the future. But this means only that the present, like all national income estimates reflect current knowledge just as they are based upon the current social standards that determine which of the numerous activities in the nation are economic, productive and hence a source of national income."

The comparisons made between the present estimates of the Bureau and those of Mr. W. I. King, the Department of Commerce and the Bureau's own earlier estimates show wide differences. However, these differences occur in much the same items, the widest discrepancies occurring in the heading "net savings" both of individuals and of enterprises—one of the most controversial areas of definition. Mr. King, in particular, interpreted savings as including gains in the purchasing power of property values held by individuals, an interpretation which would not be held valid to-day. Generally speaking, however, the differences in the estimates can be attributed very largely to differences in the definitions of what should be included or excluded from the various items. This indicates the second main field which must be covered if we are to have in future satisfactory estimates of such magnitudes as national income. Not only must more adequate data be made available, preferably by a Government service, but agreement must be reached on the scope of the definitions of the items which comprise these magnitudes. Just as the prospects of reducing those wide swings between prosperity and depression are prejudiced by the differences of opinion among experts as to the causes of the trade cycle, so are the prospects of forcing Governments to accept the need to provide greatly improved statistical services impaired by the unwillingness of experts to decide amongst themselves what they want.

A last word must be said about the format and presentation of these volumes. Both the written text and the tables are presented in exemplary form, and the indexes which cover the text and the tables are a model of their kind.

J. E. W.

4.—*Standards of Living, Wages and Prices*. By H. Belshaw. Wellington: Modern Books (London: Fabian Bookshop). 1941. 8½" × 5½". 48 pp. 1s. 6d.

In looking forward to the post-war world and the problems which will then arise, one may do so from many different angles and with varying degrees of optimism or pessimism, according to one's temperament and the character of the latest news. But if one wishes to outline any serious plans for the future, it is obviously necessary first of all to choose certain basic assumptions from the many which spring to the mind. Should one, for example, assume that the post-war world will be similar to or very different from the pre-war world in political and economic organization? Some think or believe that capitalistic democracy will persist for some time, if not for a very long time, to come. Among these is Professor Belshaw, who, in the pamphlet under review, has adopted this approach because he holds that any democratically elected government, even if setting out to build a new social order, would have to adopt capitalism if it wished to remain in power long enough to proceed very far towards its aim.

The study is confined mainly to the financial problems, possibilities, and

limitations of a capitalistic democracy in peace-time as shown by the recent history of New Zealand. This has a peculiar interest for English readers, since it throws into relief the moulding influences in a country which resembles our own in many ways other than its dependence on external trade, a country of untold if in some ways uncertain potentialities, which led ours in social legislation, in old age pensions and family allowances, yet singularly lagged behind in other directions, such as national health and unemployment insurance schemes.

New Zealand, which early in the century led the world in social experiments, seemed to drowse until 1938, when the Social Security Act of that year—passed just before a General Election—once again placed New Zealand in the forefront of the race for so-called social security. Yet the author raises the question whether governmental policy in recent years has been quite so effective in promoting improvement as its more enthusiastic supporters would claim. But he prominently displays a table of total private incomes in New Zealand, showing the total rising from £91 millions in 1922–23 to £186 millions in 1938–39, an increase of over 100 per cent. in six years! Even when he reduces these figures on the basis of average (1926–30) retail prices, he shows an increase from £109 millions in 1932–33 to £195 millions in 1938–39. One might forgive an enthusiastic Government supporter for finding great satisfaction in such figures. To say, as does the author, that the real income of consumers has risen by substantially less than these figures suggest is less convincing, perhaps, than if he had made specific deductions, or made allowance for the higher population by giving per head or per adult male head figures. Above all, he might have based his comparisons on figures for some years before the catastrophic year of 1931.

He provides many other figures of interest to the social student: for 1938–9, he gives an average income of £115 per head of the whole population; an average income of £253 for males over sixteen years of age, or, excluding those (mainly juniors) with incomes under £150, an average of about £334. A table is added showing the percentage of male income receivers in each income group, but it is a pity the author could not find space for further details, as it is a little difficult to reconcile this table with certain official figures and, indeed, with some of his own averages. His most unfortunate table is the one on page 30, and here one may be forgiven for wondering whether one of the numerous semi-destructive yet not disastrous earthquakes which often trouble New Zealand happened to occur when the book was being printed or the proofs were being read.

Apart from these minor points, Professor Belshaw has, in spite of the handicap of limited space, managed to give us much useful information and to provide a sound and illuminating guide to a little explored territory, that of the close interrelation of politics and finance. The theme well deserves treatment on a larger scale, and the quality of the present work makes us hope that the author will some day write a longer and more comprehensive study of New Zealand's politico-financial history. By that time he may, instead of prophesying, be able to tell us how a community, largely dependent on external trade yet possessing a highly developed financial system, will actually act and react in a world of fundamental change.

C. O. G.

5.—*The Theory of Incidence of Sales Taxation.* By John F. Due. New York: Kings Crown Press. 1942. 10½" × 8½". xii + 258 pp. \$2.25.

The object of this book is to bring the theory of the incidence of sales taxation into line with modern value theory. In consequence the various imperfectly competitive situations are fully treated, and indeed they receive special emphasis owing to the dominance of conditions of imperfect competition in the distributive trades. The effect of sales taxes is not only traced through to the producer, consumer, and landlord, but beyond into the markets for labour and capital, and in this connection the fullest use is made of modern developments in the handling of unemployment and interest-rate questions. Perhaps the most interesting departure from the classical treatment of the subject, however, is the

consideration of the effect of sales taxes imposed at some particular stage upon the various other stages in the productive process, and this leads naturally to a comparison of the incidence of a general sales tax with that of a retail sales tax.

The author appears to have welcomed all theoretical and practical difficulties, and having overcome them, presents his solutions with the aid of the diagrammatic method. He deals with the difficult theoretical problem of joint products and price discrimination, and manages to accommodate the intractable subject of advertising and selling costs quite comfortably in his analysis. With regard to practical difficulties, he does not shirk discussion of the possibilities of quality variation, nor of the habit, widespread among business men, of fixing prices on the basis of average rather than marginal costs. It is the retail trade, however, which furnishes most obstacles to the theorist. Retail prices are sometimes maintained at particular levels by the manufacturers, and sometimes fixed by tradition. Even when retailers are free from such price restrictions, they introduce rigidities of their own by quoting prices in guineas, or in round figures, or by resorting to the pricing device so commonly used in the drapery establishments of this country of marking goods at 3s. 11½d., 4s. 11½d., and so forth. Dr. Due, however, manages to cope with these frictions, and by making full allowance for the idiosyncrasies of business practice, he saves his theory of sales tax incidence from being spoilt by undue abstraction.

While the author avoids unnecessary abstraction, his treatment of the subject is nevertheless purely theoretical, and no reference is made to actual taxes on particular commodities or businesses in the analysis. At the time the book was written, the United States had no general system of sales taxation, and such examples of it as did exist in some of the individual States are discussed briefly in an appendix. Two other appendices deal respectively with chain store taxes and processing taxes under the Agricultural Adjustment Act. The text is illustrated by twenty-six diagrams, and the book concludes with a double bibliography covering works dealing with the incidence of sales taxation, and the principal works on economic theory and pricing practices which have served as a basis for the analysis.

Perhaps the most interesting feature of the whole work is the determined attempt to keep the analysis as close as possible to reality, a course which, it may be mentioned, does not lead the author to complicate his argument unduly. The diagrams largely illustrate straight-line demand and cost curve situations, but in spite of this, they are quite adequate for their purpose. The appendices dealing with practical cases of sales and kindred taxes are rather condensed, and while little would have been lost by their complete omission, much might have been gained by their expansion.

The volume itself is notable as representing an experiment in low-cost publication. In appearance it is a loose-leaf book with a thick paper cover of the parchment type. According to the foreword by Carl Shoup, the publication is "based on the assumption that important scholarly works in economics for which the market is somewhat limited will be just as useful in offset reproduction as in the letterpress form, which is unavailable because of expense." The typography is good, but having regard to the binding, I cannot but feel that it will be difficult to convince even a lukewarm book-lover that such a publication is worth buying at a price which approximates to half a guinea in English money. At any rate, where books are concerned, I am definitely conservative, and while fully aware of the difficulties of publishing work of this type, I hope that publications in this form are restricted to a very limited field indeed. T. M. R.

6.—*The Economic Effects of Advertising*. By Neil H. Borden. Chicago: Irwin. 1942. 9" x 6". xl + 988 pp. \$5.

This elaborate study is the result of four years' research, made possible by a grant of \$30,000 to the Harvard Business School. Professor Borden was in charge of the group conducting the investigations, and no effort has been spared

in endeavouring to make reticent business men part with that most precious of all economic values : economic data.

As a result, this book contains a most impressive array of newly compiled statistics. The effects of advertising on the demand side are presented in great detail, with studious analyses in the cases of tobacco, sugar, fruits, refrigerators and a score of other commodities. Still more valuable are the figures showing the effects of advertising on marketing costs (substituting or supplementing other selling efforts) and—to a smaller degree—on production costs. The data illustrating the relation of advertising to prices and pricing practice will prove most interesting in connection with the Theory of Value ; while, in discussing the effect of advertising on the national income and cyclical fluctuations, the book links up successfully with some of the controversial problems of to-day. Indeed, in all economic literature, there hardly seems to be any reference to advertising which has not been taken up by Professor Borden, and discussed with illuminating scrutiny ; it is all the more unfortunate that Marshall's few remarks on the subject (in his *Industry and Trade*) should have escaped the author's attention.

Professor Borden's definition of advertising includes display, posters, circulars, broadcasts, labels, etc. ; it does not take into account demonstrations and exhibitions, free samples and other advertising allowances. This definition seems rather arbitrary, however hard it may be to draw a line amongst the numerous types of aggressive selling activities. It is, however, certainly helpful in providing us with serviceable statistics, and, on the above basis, the yearly advertising expenditure in the United States, since 1920, seems to have been of the order of 2000 million dollars, *i.e.*, approximately 3 per cent. of the national income. The expenditure follows fairly closely the ups and downs of the trade cycle. Computations for 1935 show the following estimated analysis of the above sum : Newspapers : 30.5 per cent. ; Periodicals : 11.8 per cent. ; Radio : 6.2 per cent. ; Direct Advertising (mail, etc.) : 29.4 per cent. ; Advertising Department Administration : 10.0 per cent. ; Miscellaneous : 12.1 per cent. Of this expenditure, about 380 million dollars are estimated to have been returned to consumers in the form of low-cost periodicals and free radio entertainment. This allowance might well prove to be too high in view of the fact that, in calculating it, the profits of the publishing and broadcasting enterprises have not been taken into account.

The above figures clearly show the importance of advertising in the national expenditure of the United States ; the problem is to obtain some measure of its usefulness. The greater part of the book is devoted to this much-debated subject and, as a result of the evidence supplied by a welter of statistics, surveys and interviews, the very complex and qualified conclusions of the book seem on the whole to favour the view that most advertising is beneficial to the community. One cannot help feeling that the statistics to support such a view are hardly conclusive ; there is, however, another aspect of the question. If, under modern competitive capitalistic society, equilibrium is possible on various levels of employment, advertising, in stimulating (or, as in war-time Britain, discouraging) demand, might be a useful factor in regulating the economic activity of the nation. The question lies entirely outside the scope of this book. But it adds new significance to the direct effects of advertising on demand, the quantitative measurement of which is imbued with innumerable difficulties. In this, Professor Borden might have failed, and one could hardly expect conclusive statistical evidence where simultaneously operating factors cannot be isolated. But he must be congratulated for a most laborious and highly successful effort in bringing the valuable material of the book within our reach.

G. A. B.

## STATISTICAL NOTES

### 1. BRITISH OFFICIAL STATISTICS

ALTHOUGH there was some decline in general *wholesale prices* during June 1942, due to the fall in the prices of malting barley and imported hides, there was a slight general advance during the three months April to June 1942. Tobacco prices rose steeply from April 15th owing to the increased duty, lead sheets and piping in June advanced 4 per cent. and 7 per cent. respectively, and there was some increase in copper prices. On the other hand, there was a seasonal fall of 11 per cent. in the contract price of milk in May, and the controlled price of tomatoes fell in June about 14½ per cent. There was practically no change in the wholesale prices of meat, fish and eggs during the first six months of 1942. The general Board of Trade index-number (average for 1930 = 100) rose from 158.8 in March to 159.8 in June 1942, or about 0.6 per cent. The index-number for food and tobacco rose 1.6 per cent., and that for industrial materials and manufactures 0.2 per cent. Since the commencement of the war general wholesale prices had by June 1942 advanced nearly 63 per cent., food prices by nearly 77½ per cent. and industrial materials and manufactures by nearly 56 per cent. Of the sub-groups in the index-number, cereals had advanced 132 per cent., "other food and tobacco" (excluding meat, etc.) nearly 76 per cent., basic materials (excluding fuel) 77 per cent., cotton 76 per cent., other textiles (excluding wool) 72 per cent., and the miscellaneous group of materials nearly 78 per cent. To a great extent wholesale prices and supplies are fixed or controlled (or both fixed and controlled), and in some cases where the article is subsidised the prices charged are less than those at which they have been purchased by the Government.

Compared with twelve months earlier, general prices in June 1942 had advanced 4.8 per cent., food prices 10½ per cent. and prices of materials about 2 per cent. The advance in food prices was chiefly due to a rise of 33 per cent. in the prices of cereals. The prices of meat, fish and eggs fell about 3 per cent., and those of other food and tobacco advanced 6.4 per cent., owing principally to the increased tobacco duties.

The Board of Trade index-number of wholesale prices is given below for the months March to June 1942, together with the percentage increases at June 1942 over the prices at the specified dates.

No very noticeable advances in price have taken place since the first sixteen months of the war, except in the sub-group of cereals, which has risen since December 1940 about 32 per cent. There has been an actual decline of about 4 per cent. in the meat, fish and eggs group of prices. On the whole, prices remain stationary and are likely so to continue.

Date	Total Food	Total not Food	All Articles	Basic Materials	Intermediate Products	Manufactured Articles	Building Materials
March 1942 ...	157·9	158·9	158·8	168·3	167·9	151·7	142·9
April „ ...	159·8	159·2	159·6	168·6	168·0	152·2	143·3
May „ ...	162·6	159·4	160·7	169·1	168·1	152·2	143·3
June „ ...	160·4	159·2	159·8	167·9	168·3	152·3	143·6
June 1941 ...	145·1	156·1	152·4	167·0	165·6	148·5	139·3
Dec. „ ...	150·5	158·4	155·9	170·5	167·7	150·3	141·8
„ 1940 ...	144·5	150·4	148·6	158·2	160·7	144·3	132·8
„ 1939 ...	118·1	124·3	122·3	135·0	125·0	122·0	110·3
Aug. „ ...	90·4	102·2	98·1	94·5	104·0	108·7	104·1
Percentage increase in June 1942 over—							
June 1941 ...	10·5	2·0	4·9	0·5	1·6	2·6	3·1
Dec. „ ...	6·6	0·5	2·5	1·5*	0·4	1·3	1·3
„ 1940 ...	11·0	5·8	7·5	6·1	4·7	5·5	8·1
„ 1939 ...	36·7	28·1	30·9	24·4	34·6	24·8	30·2
Aug. „ ...	77·4	55·8	62·9	77·7	57·0	40·1	37·9

\* Decrease.

The figures for other well-known British index-numbers are given below, together with those of the United States Bureau of Labour.

Date	Board of Trade (1930 = 100)	Economist (1927 = 100)	Statist (1866-77 = 100)	The Times (1913 = 100)	U.S. Bureau * of Labor
March 1942 ...	158·8	110·3	153·5	179·1	97·2
April „ ...	159·6	110·6	154·5	179·8	98·2
May „ ...	160·7	110·9	156·6	181·5	98·7
June „ ...	159·8	110·7	154·4	181·6	98·4
June 1941 ...	152·4	104·8	144·4	170·2	86·9
Dec. „ ...	155·9	108·5	146·5	171·7	93·1
„ 1940 ...	148·6	100·9	134·5	165·2	79·8
„ 1939 ...	122·3	91·7	120·1	142·5	84·3
Aug. „ ...	98·1	70·3	90·4	114·5	80·5

\* Mean of weekly figures.

General wholesale prices in the United States have advanced about 22 per cent. since the war started, but primary products had advanced nearly 54 per cent. by the end of June 1942. Similar products in Great Britain have advanced about 38 per cent., according to the Bank of England index-number. Since the United States entered the war both general wholesale prices and the prices of primary products in the U.S. have advanced about 7 per cent.

During the first six months of 1942 there has been little change in the index-number prepared by the Ministry of Labour and National Service to indicate



changes in the *cost of living* of the working classes. Retail prices of food have fallen about 3 per cent., chiefly due to reductions in the prices of sugar and eggs. On the other hand, there was a rise in clothing prices of about 2 per cent., increased prices for articles of domestic ironmongery, brushes and pottery, and a substantial advance in the prices of tobacco and cigarettes of about 37 per cent., owing to the duty being increased in April 1942. There was a seasonal increase in the price of milk averaging about  $\frac{1}{4}$ d. per quart at July 1st. The basis of the Ministry's index-number is calculated on the retail prices at July 1914 of the principal articles of working-class consumption, and "no allowance has been made for any changes in the standard of living since that date or for any economies or readjustments in consumption and expenditure since the outbreak of war."

The index-numbers for certain specified months are given below.

(Prices at July 1914 = 100)

Date		Food	Rent and Rates	Clothing	Fuel and Light	Other Items	Total
April 1st, 1942	...	160	164	405	232	235	199
May 1st, "	...	160	164	405	232	263	200
June 1st, "	...	159	164	405	232	263	199
July 1st, "	...	160	164	405	232	264	200
Jan. 1st, 1942	...	163	164	400	230	233	200
July 1st, 1941	...	167	164	375	228	227	199
Sept. 1st, 1939	...	138	162	205-210	180-185	180	155

Since the beginning of the war food prices have advanced about 16 per cent., prices of clothing about 95 per cent., fuel and light about 27 per cent., and other items of expenditure about 47 per cent. The total index-number has advanced rather more than 29 per cent. There has been very little change in the cost of rent and rates, owing no doubt to the Rent Restriction Acts.

THE annual *index-number of agricultural prices* calculated by the Ministry of Agriculture for the year 1941 shows that on the average in the second year of the war prices were 65 per cent. above the level of the three years 1937-39, though the actual rise in the year as compared with 1940 was somewhat less than 20 per cent. The fluctuations in the past five years are shown below, divided into three groups of commodities. In calculating these figures allowance has been made for Government subsidies—chiefly in respect of wheat, barley and oats, cattle and milk.

Base 1927-1929 = 100

	1937	1938	1939	1940	1941
Cereals and farm crops ... ..	98 $\frac{1}{2}$	86	91 $\frac{1}{2}$	124 $\frac{1}{2}$	151
Live stock and live-stock products ... ..	88	88	90 $\frac{1}{2}$	121 $\frac{1}{2}$	136
Fruit, vegetables, and glasshouse produce ... ..	93	105 $\frac{1}{2}$	88 $\frac{1}{2}$	145 $\frac{1}{2}$	228
General index ... ..	90 $\frac{1}{2}$	90	90 $\frac{1}{2}$	125	149 $\frac{1}{2}$

Among the farm crops, wheat, barley, potatoes and hay showed moderate increases, but in the live-stock group which is by far the largest of the three divisions the gains were not very important though milk the chief single commodity in this group showed an increase from 134 in 1940 to 158 in 1941. Fruit and vegetables rose considerably, but owing to their smaller aggregate value they affect the general index less than the products in the other two groups.

In the first six months of 1942 prices seem to have made a marked advance, the average monthly index-number (corrected for seasonal variation) being 160 in January and 171 in June as compared with 137 in January and 144 in June of the previous year.

Comparison with the figures ruling in the last war shows that the 1941 index of 149½ is exactly half-way between the averages for 1917 and 1918. The old index of agricultural prices, adjusted to a basis corresponding with the present series of index-numbers, reached 139 in 1917 and 160 in 1918.

The numbers recorded as unemployed continue to decline slightly month by month, *employment* being maintained at a high level with a demand for additional workers of all classes in most industries. On June 15th, 1942, the number of unemployed workers remaining on the registers of the Employment Offices of the Ministry of Labour and National Service was only 106,170 compared with 135,762, at the middle of March, and 263,201 at the middle of June 1941. No doubt the large majority on the registers are merely in the period of "changing jobs." About 3,670 were reported at the middle of June as only temporarily stopped, and of the women and girls 1,445 are stated to be unable for good cause to transfer to another area. In June 1942 24,870 men and boys were classified as "unsuitable for ordinary industrial employment" and 1,374 women and girls as "unsuitable for normal full-time employment." These numbers are excluded from the totals in the following table, the figures in which have been amended for June 1941 to agree with the present practice of the Ministry.

Date	Wholly Un-employed	Temporarily Stopped	Persons normally in Casual Employment	Total	Males	Females
March 16th, 1942 ...	121,646	8,236	5,880	135,762	77,231	58,531
April 13th, " ...	117,048	6,481	3,970	127,499	76,549	50,950
May 11th, " ...	108,963	5,789	3,232	117,984	71,321	46,663
June 15th, " ...	99,240	3,670	3,260	106,170	67,629	38,541
June 16th, 1941 ...	204,918	47,733	10,550	263,201	114,648	148,553
Aug. 14th, 1939 ...	968,108	211,978	51,606	1,231,692	947,099	284,593

It seems unlikely that during the war there can be any likelihood of an appreciable reduction in the numbers recorded as unemployed. In the period before the last war and in times of good employment it was estimated that the number of workpeople in the "process of changing jobs" was considerably in excess of the number now unemployed.

There was an increase in the daily average value of *retail sales* during the first four months of the trading year (February to May 1942), as shown by the figures prepared by the Bank of England in conjunction with various retail distributors' Associations and Co-operative Societies. The sales of food products increased by 3.0 per cent. and those of other merchandise by 1.8 per cent., the overall increase being 2.5 per cent. Such figures indicate a very considerable decline in the *quantities* of goods sold.

## 2. OTHER STATISTICS.

*THE prices of agricultural produce in the United States* as reported in the index-numbers issued by the Bureau of Agricultural Economics have recently shown an appreciable rise. The general average in 1939 was 93 (1910-14 = 100), and 98 in 1940, but in 1941 the effects of the war began to be more marked and the average rose to 122; much of the increase took place in the latter part of that year, and the monthly figure for January 1942 was 149. This increase was accompanied by a somewhat less marked increase in the corresponding index-number of prices paid by farmers for commodities used in production and living, so that for the first time for some years an approximate parity was attained between the index of goods sold and the index of goods bought. These index-numbers represent a statistical device which has been very widely used in the United States as a means of measuring agricultural prosperity or depression: the theory being that the average prices received by the farmer should bear a consistent and uniform relationship to his general cost of production, the two being measured by index-numbers based on 1910-14. The price index of products sold covers all the principal crops and live stock (some 27 items), while the index of commodities purchased includes feeding stuffs, fertilizers, seeds, machinery, equipment and supplies, as well as a large number of articles for family maintenance, such as food, clothing, furniture, etc., in all some 180 items. These are mostly retail prices. The weighting of both series has been revised to correspond with later information.

In the depression which followed the last war, agricultural prices fell at times much more than non-agricultural prices, and it became an accepted principle among the farming community that this disparity was unfair and inequitable,

Index-Numbers of Commodities

	Sold by farmers	Bought by farmers	Ratio
1910-14 ... ..	100	100	100
15-19 ... ..	161	151	107
20-24 ... ..	151	161	94
25-29 ... ..	147	155	95
30-34 ... ..	88	122	72
35-39 ... ..	106	124	85
1940 ... ..	98	123	80
1941 ... ..	122	133	92
1942 (January) ... ..	149	146	102

and hence that what was needed was "parity prices." The principle was indeed incorporated in some of the farm legislation as an indication of the aim to be

kept in view in schemes for assisting agriculture. However, notwithstanding the heroic measures for farm relief which have been taken in the United States throughout the period since 1920, the disparity has continued to show itself as will be seen from the table below. On the average up to 1929 it was not very marked, but in 1930-34 it became pronounced, the difference rising to 28 per cent., while in 1935-39 it averaged 15 per cent., and in 1940 was 20 per cent.

The idea that two index-numbers based on very different commodities can be expected to run together uniformly over a long period of time is certainly open to criticism, and it appears from the *Year Book of the Department of Agriculture* for 1940 that the principle of "parity price" has been to some extent abandoned, and that the Department "has come to believe that parity income constitutes a more justifiable expression of the concept of agricultural-industrial balance than does parity price." Parity income apparently means some reasonable equality between town and country incomes, or between earnings in rural and non-rural areas, but, as the Department goes on to explain, "the fact that incomes cannot be determined with the same statistical accuracy as prices greatly reduces the usefulness of the income criterion."

Although not directly connected with the idea of "parity income," it may be noted that what is called "Cash farm income" in the United States—that is, income from sales of produce and analogous receipts—in 1941 was the largest for any year since 1920 and 29 per cent. higher than that received in 1940.

## CURRENT NOTES

*Nutrition and Size of Family*,\* a report prepared for the Birmingham Social Survey Committee, makes a useful contribution to a discussion which is arousing much interest just now. The survey, which was carried out during the months April-August 1939, enquired into "The relation of family income to the cost of certain basic needs and more especially the relation of the amount of money available for food to the cost of an adequate diet." The district investigated was a new housing estate (Kingstanding Estate, built in 1929-30), chosen in order to eliminate the effect of inadequate housing, and households with no children under 14 (about 33 per cent. of the total 5,300) were not included in the sample taken, which was designed to consist of approximately 50 families each of six size-groups—i.e., from one child to six or more under 14. Out of 3,600 such families 302 were scheduled, and complete information was obtained from 263 of them. The "sufficiency" of income was measured in two ways: (1) by comparing *net income* (total income less rent, compulsory insurance, and fares) with an assumed minimum standard of expenditure on food, fuel, light, clothing, and cleaning materials; (2) by comparing with a minimum standard of cost the *balance of housekeeping money theoretically available for food* after paying an assumed minimum on the non-food items plus voluntary insurances and regular hire-purchase instalments; this method excludes the money kept by the wage-earner for his personal use, and is therefore considered to give a truer picture. The minimum standard taken for food cost was the cost of the minimum diet set out by the British Medical Association in 1933, but, as is pointed out, this indicates the amount of nutrition obtainable for the money by

\* Allen & Unwin, 2s. 6d.

judicious expenditure, and is not a true measure of that actually obtained; moreover, the "sufficiency" diet is a minimum standard. The results show once again that poverty and malnutrition are positively related to the number of children in the family. Of households with six or more children 8 per cent. were on the borderline of the "sufficiency" standard, or definitely below it by the first measure and 96 per cent. by the second; where there were four children the figures were 55 per cent. and 85 per cent., with one child only, 3 per cent. and 13 per cent. It is estimated that out of a total of about 8,150 children 31 per cent. by the first measure and 61 per cent. by the second were inadequately provided for. This may be compared with the 54.5 of children in like case given in the Bristol Survey. Like that Survey, the Birmingham enquiry was carried out in a time of general prosperity and expanding employment. The inadequacy of re-housing as a remedy is plainly shown; the reason is largely that the improved environment is apt to cost more in rent, transport, wear and tear of shoes, etc., and while it induces larger appetites food prices tend to be higher.

THE Co-operative Permanent Building Society is issuing, through Messrs. J. M. Dent, a series of pamphlets, of about 30 pages each and costing sixpence, under the general title *Design for Britain*. They are edited by Dr. Edwin Fairchild, who also contributes to the series. The broad aim is to show the part that building societies could and should take in "reconstructing" this country after the war, and to assist in educating public opinion respecting town, village and home planning. The series opens well and practically with *Signposts of Building Society Finance*, in which Mr. Arthur Webb, himself a building society official, reviews the Building Society movement in a constructively critical manner, envisaging greater usefulness to the community in future. Professor Joad and Miss Ethel Mannin (it will be seen that the authors are drawn from various professional categories) in *An Old Countryside for New People* and *Castles in the Street*, respectively, show forcibly and picturesquely how bad things are and why; Mr. Streeton Steed (*Cottages and Countrymen*) and Mr. W. R. Davidge, F.R.I.B.A. (*Place for the New Architecture*) set down what they should or might be; Mr. Davidge includes some very interesting extracts from *London and Westminster Improved* (1766), by John Gwynn, architect, whose foresight is seen to have been remarkable and whose criticisms are often still relevant. Professor Harry Jones, in *Industrial Background for Housing*, outstanding for its objectiveness and concision, gives a clear view of the foundation on which all planning must rest—the location of industries, basic, subsidiary and local, fixed or movable, which again depends greatly on the future size and structure of the population. *National Planning and Re-development*, by H. P. Cart de la Fontaine, briefly but capably surveys the whole question, and includes an account of what was done—and not done—to reconstruct the devastated areas of France and Belgium after the last war. Seventeen of the booklets have so far appeared, and the series may be called interesting and informative; many of the writers have evidently used a statistical scaffolding.

THE following list of Fellows elected at the Ordinary Meeting on March 17th, 1942, was accidentally omitted from the report of the proceedings printed in Part I of the *Journal*.

Cecil John Baker.  
 Percy Frederick Carpenter, F.C.A.  
 Lily Agnes Coote.  
 Herbert Edmund Crookes.  
 Edwin Henry Dowker.  
 Reginald Grant Forrester.  
 Percy Thomas Frank Golding.  
 Jack Louis Grumbridge.  
 Mohamed Mazloun Hamdi, B.Sc.  
 Edward Stanley Hanson, F.L.A.A.  
 Harold Buckley Hanson.  
 Mahmoud Mostafa Hassanein.  
 Phiroze Jamshedji Jeejeebhoy, B.A.  
 John Andrew Knapp.  
 John Baptist Leslie.  
 William John Martin.

Khint Maung, B.Sc.  
 John Norman Monk.  
 Jose Enrique Moyal.  
 The Hon. George Peel, M.A., D.L.  
 Augustine St. Clair Penny.  
 F. E. Richmond.  
 Isaac Vincent Robinson, M.Inst.C.E.  
 H. Samuel.  
 H. H. Seet.  
 Trevor William Snook, A.C.I.S.  
 Sydney Walker.  
 Lt.-Col. Myers Wayman, O.B.E., J.P.  
 Gilbert Vincent White.  
 Frank Henry Binham Williams.  
 J. G. Wilson.  
 William Arnold Wood.

#### *Corporate Representatives*

Dr. Rudolf Bičanič, *representing* the Yugoslav Ministry of Finance.  
 Dr. John Brugel, *representing* the Czechoslovak Ministry of Economic Reconstruction.  
 Eustace Woods Harrington, F.I.A., *representing* the Northern Assurance Company, Ltd.  
 Philip Maurice Hill, *representing* the Chamber of Shipping of the United Kingdom.  
 Edwin C. Fairchild, Ph.D., *representing* the Co-operative Permanent Building Society.  
 Mrs. Feodora Stone, *representing* the National Institute of Economic and Social Research.  
 Mervyn Edward Wise, *representing* the Mullard Radio Valve Factory.  
 Maxime Wynants, *representing* the Belgian Commission for the Study of Post-War Problems.

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## OBITUARY

SIR ALFRED WILLIAM FLUX, C.B.

THE Council have learned with deep sorrow that Sir Alfred Flux, Honorary Vice-President of the Society, died of pneumonia in Denmark on July 16th at the age of seventy-five. His friends had greatly hoped that he would live to see the end of the war with the victory of his own country and the liberation of the one where he had made his home, but it was not to be.

Alfred William Flux was born at Portsmouth on April 8th, 1867, and was educated at Portsmouth Grammar School and St. John's College, Cambridge. In the early part of his university career, his work was mainly mathematical, but later he studied under Alfred Marshall, and developed a lasting interest in economics. His regard for Professor and Mrs. Marshall lasted all his life, and whenever he visited Cambridge he called on them. He was bracketed Senior Wrangler at the early age of twenty, and was awarded the Marshall Political Economy Prize in 1889, being elected a Fellow of St. John's College in the same year. His first lectureship was at Owens College, Manchester, where he took up the appointment of Cobden Lecturer in Political Economy in 1893. In 1898 he became Stanley Jevons Professor of Political Economy at Owens College, but three years later he left this country to become William Dow Professor of Political Economy at McGill University, Montreal. This post he held until 1908, when he returned to England to begin the work in the Board of Trade for which he is best known to Fellows of this Society. His *Economic Principles*, which became one of the standard text-books on its subject, was published while he was in Canada.

Of his earlier work in the Board of Trade, Sir Hubert Llewellyn Smith has written:

"Alfred Flux as a Board of Trade official was in the direct line of succession to two statistical giants—G. R. Porter (of *Progress of the Nation* fame) and Robert Giffen. Porter was called in by Lord Auckland in 1832 to organize a Bureau of Statistics that should publish data for the enlightenment of the public and not merely for the guidance of Government. When, forty years later, the Commercial Department of the Board of Trade was dismembered and the bulk of it transferred to the Foreign Office, the statistical branch was fortunately left behind, and it grew rapidly in scope and importance, especially after the appointment of Robert Giffen in 1876 and the subsequent creation of a Labour Department, the germ of the present Ministry of Labour.

"Flux entered the Board of Trade service in 1908 as Statistical Adviser on the personal staff of the Controller-General of the Commercial, Labour and Statistical Department. The first Census of Production Act had recently been passed, and Mr. David Schloss was the first Director. After his retirement early in 1908, and an interval during which the functions of Acting Director were performed by the Principal for Statistics, Mr. (now Sir Henry) Fountain, Flux was definitely appointed Director of the Census at the beginning of 1911 and was responsible for the final Report.

"In this work Flux's right-hand man was Henry Macrosty, whose appointment (as Assistant Director) actually antedated his own. This was the beginning of a long, valuable and harmonious co-operation in which the two men worked in the closest and most intimate collaboration with regard to the subsequent

Census of Production Inquiries of 1912 and 1924. The 1930 Census was taken after Macrosty's retirement. My own official contact with Flux's work ceased in 1927 when I retired from the Board of Trade.

"I have spoken especially of the Census of Production because that was the first and most conspicuous piece of work that Flux was called on to perform. But of course his range of statistical activity and his beneficial influence on the statistical services of the country were very much wider and more far-reaching. Personally, I always felt immensely strengthened and relieved by the conviction that I could rely with complete confidence on the statistical soundness of any report for which Flux was responsible. And this was perhaps especially the case during the troublous years 1914-18, when my own thoughts and efforts were necessarily absorbed by war problems.

"In April 1918 Flux became an Assistant Secretary in charge of the Statistical Department, an office which he filled with distinction until his retirement in 1932—exactly a century after the creation of the Bureau of Statistics by his predecessor, George Porter."

During the latter part of his official career he did a great deal of work on interdepartmental and international committees. He represented the Board of Trade on such committees as that responsible for the revision of the occupational and industrial census classifications, and also on the Permanent Consultative Committee on Official Statistics, and he was Chairman of the Committee dealing with the revision of the Trade Returns in 1919, being primarily responsible for the complete recasting and reclassification then effected.

The international aspects of economic statistics were of great interest to him. He was elected a member of the International Institute of Statistics in 1923, and an honorary member (a rare distinction) in 1929. As one of the original members of the Committee of Statistical Experts appointed by the League of Nations under the International Convention relating to Economic Statistics, 1928, he took a prominent part in the work of this Committee, presiding over some meetings and being Chairman of several Sub-Committees. It was in the very detailed work needed to set up common standards for international statistics that Flux excelled. His thorough knowledge of a number of European languages was invaluable, as also were his most retentive memory for facts and his meticulous accuracy. His work was done in close touch with the Board of Trade, but it was in his individual and not his official capacity that he was appointed.

Among all his varied statistical and economic interests, however, the nearest to his heart was the Royal Statistical Society. He joined the Society in 1893, at the age of twenty-six, and was elected a member of Council in 1908. Two years later he was appointed an Honorary Secretary, the others then being Henry Rew and G. Udny Yule, and he held this office until he was made President in 1928. He was a member of the Library Committee set up in 1911, of the Housing Committee of the same year, and, from time to time, of many other Committees and Sub-Committees. In short, he was identified with most of the Society's activities, the exception, rather strangely for one who was a Senior Wrangler, being those concerned with the mathematical-methodological aspects of statistics and economics, in which he seemed to take comparatively little interest. From the beginning he showed that understanding of the spirit and traditions of the Society and enthusiasm for its aims which made him so zealous a participant in its work and so valuable a member of the Council. The affinity was rooted in his character: William Newmarch's phrasing of the Society's



principle as "truth followed with a single purpose in a patient spirit and with honest zeal" may well serve to describe the creed and life work of Alfred Flux.

Notwithstanding the exacting nature of his duties at the Board of Trade, he was always ready to give time and labour to the affairs of the Society. During the greater part of the 1914-18 war, when there was no Assistant Secretary, he superintended the work of the office and edited the *Journal*, and during the whole of his Honorary Secretaryship his help was always generously given to the staff, and his kindness and patience were inexhaustible. His outstanding traits were, indeed, kindness and consideration for the feelings of others and keenness of perception, though a certain formality of manner was sometimes mistaken for aloofness. The urbanity which characterized his intercourse with all and sundry became almost a fault in his public speeches and writings, for the smoothly flowing curves of the prose were apt to lull the attention and to blunt the edges of the argument, able though it was, but his somewhat involved phraseology was due chiefly to his anxiety to express, without possibility of misapprehension, the exact shade of meaning he intended to convey. He read many papers before the Society and contributed others to the *Journal*. These covered a wide variety of subjects, and three may be singled out as indicating the creative nature of his mind and the practical direction of his genius. "The National Income" (1929) was outstanding in this respect, the estimate of the national income being compiled from the production side as against the method based on the aggregate of individual incomes, formulated by his predecessor, Sir Robert Giffen. He was responsible for compiling an index of production for this country, and discussed the problems involved in a paper entitled "Indices of Industrial Productive Activity" (1927). The earliest of the papers deserving special mention is "Measurement of Price Changes" (1921), being a description of the new Wholesale Prices Index Number of the Board of Trade, and for this he was awarded the Guy Medal in silver. In 1930 he received the Guy Medal in gold "for distinguished and zealous work for the Royal Statistical Society and for the furtherance of statistical science."

Other recognitions of his work in economics and statistics were his C.B. in 1920, his knighthood, which he received at the time of the Society's jubilee, an honorary degree of LL.D. conferred on him by the University of Manchester, and his election as honorary member of the American, Czechoslovak and Hungarian Statistical Societies.

His published works, in addition to the *Economic Principles* already mentioned, were books on *The Swedish Banking System* (1910), and *The Foreign Exchanges* (1924), a revision of Jevons's *Coal Question* (1906), and numerous contributions to the *Economic Journal* and to the *Proceedings of the Manchester Statistical Society*, of which he became a Fellow in 1893 and President in 1900.

Sir Alfred married Emilie, daughter of Direktör V. Hansen of Copenhagen, and was a devoted husband. His friendships were made largely among fellow-workers in statistics and economics, both in this country and in Denmark, where, mainly on account of Lady Flux's health, he lived after his retirement. The various international meetings which he attended procured him friends and congenial acquaintances in several countries, and he travelled a good deal, visiting North America as well as many countries in Europe, until the outbreak of war restricted his freedom of movement. It was when he was over the age of seventy that he wrote that he was setting out to see the world before he was too old to appreciate it. His travels, because of his keen observation and his very

good memory, enabled him to add to the already vast store of knowledge which he possessed, and which made his conversation and his letters a source of delight to his friends.

The death of his closest friend, Macrosty, was a cause of great grief to him. In spite of his cheerful messages, the last months of his life can only have been full of spiritual anxiety and, one fears, of physical privation. So far as can be gathered, he did not suffer a long illness, for in the last message received from him, dated June 30th, he says, "Many thanks for messages of March and April. We are glad that the long keen winter is satisfactorily ended. Best greetings from both. All well."

H. L.

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## STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS

### UNITED KINGDOM—

*Annals of Eugenics*, May 1942—Measurement of association in a contingency table with special reference to the pigmentation of hair and eye colours of Scottish school children: *K. Maung*. New cyclic solutions to problems in incomplete blocks: *R. A. Fisher*. On seminvariant statistics: *M. G. Kendall*. The likelihood solution of a problem in compounded probabilities: *R. A. Fisher*.

#### *The Banker*—

June 1942—Supply finance in America.

July 1942—The post-war exchange régime: a policy for British exports: *Richard Fry*.

August 1942—Finances of Northern Ireland: *The Rt. Hon. J. Milne Barbour*.

#### *Bankers' Magazine*—

June 1942—After the war—what? Post-war monetary policy.

July 1942—The Bank of England in war times: The international problem of international trade: *Akanthos*.

*Economica*, May 1942—What is the best tax-system? *Frederic Benham*. Maintaining capital intact: A further suggestion: *J. R. Hicks*.

*Eugenics Review*, April 1942—The effect of the war on the birth rate: *Richard Titmuss*. Population changes and economics: *L. J. Cadbury*.

*Institute of Bankers, Journal of the*, July 1942—The budget White Paper of 1942: *J. R. Hicks*.

#### *Oxford Institute of Statistics, Bulletin*—

June 6, 1942, No. 8—War finance in 1940 and 1941: *M. Kalecki*. The burden of the war: *J. L. Nicholson*. Advertising in war-time: *K. W. Rothschild*.

June 27, 1942, No. 9—Problems of coal production: *T. Balogh*. Costs and profits in Government contracts: *G. D. N. Worswick*.

July 18, 1942, No. 10—Shipping—the bottleneck: *F. Burchardt*. Concentration in retail distribution: *T. Balogh*.

### INDIA—

*Indian Journal of Economics*, April 1942—Marshall's contribution to Indian economics: *A. Krishnaswami*. Rural credit: *A. Krishnaswami*.

### UNITED STATES—

#### *American Economic Review*—

March 1942—The conditions of expansion: *Sumner H. Slichter*. Saving, consumption and investment, I: *Mordecai Ezekiel*. "Permanent" technological unemployment: *Hans P. Neisser*. Flexible taxes to combat inflation: *Albert G. Hart*. Fiscal policy and national income: Review: *Charles O. Hardy*.

June 1942—War finance and inflation: *William Fellner*. Future of frozen foreign funds: *Judd Polk*. Saving, consumption and investment, II: *Mordecai Ezekiel*. The inflationary gap: *Walter A. Salant*. Statistical cost functions; appraisal of recent contributions: *Hans Staehle*.

*Supplement*, June 1942—Papers relating to the Temporary National Economic Committee.

*American Statistical Association, Journal of the*, June 1942—On a classification of the problems of statistical inference: *W. Edwards Deming*. Measuring national income as affected by the war: *Milton Gilbert*. Sampling theory when the sampling-units are of unequal sizes: *W. G. Cochran*. The

- importance of hospital morbidity data for the community: *Marta Fraenkel*. A critical appraisal of business statistics: *John S. Perkins*.
- Journal of Experimental Education*, March 1942—Steps for application of the Johnson-Neyman Technique—a sample analysis: *Robert H. Koenker*. The relation of primary mental abilities to scholastic success in professional schools: *Dewey B. Stuit* and *Harry H. Hudson*.
- Journal of Political Economy*, April 1942—A model of the forty-month or trade cycle: *Joshua C. Hubbard*. Distribution of the earnings bill among industrial workers in the Soviet Union: March 1928; October 1934: *Abram Bergson*. The structure of interest rates and the Keynesian theory of interest: *David W. Lusher*.
- Milbank Memorial Fund Quarterly*, April 1942—The relation of employment levels to births in Germany: *Dudley Kirk*. Nutritional failures: their causes and prevention: *Norman Jolliffe*. Medical evaluation of nutritional status, Part IX: *Eleanor P. Hunt* and *Kenneth M. Hayden*.
- Quarterly Journal of Economics*, May 1942—Consumption in Germany during the period of rearmament: *Otto Nathan*. Relationship of the cycle in yields of cotton and apples to solar and sky radiation: *J. L. Fulmer*. Taxation and economic stability: *Donald W. Gilbert*.
- Review of Economic Statistics*, May 1942—Some notes on point rationing: *E. M. H. Lloyd*. The dynamics of inflation: *Tjalling Koopmans*. Housing policy and the building cycle: *Leo Grebler*. War-time price control and price movements in an open economy: Australia, 1914–20 and 1939–40: *E. R. Walker*, *R. J. Linford*.
- Social Research*, May 1942—International monetary co-operation: *Albert Halasi*.

#### SWITZERLAND—

- Zeitschrift für schweizerische Statistik und Volkswirtschaft*, 1941—IV—Schweizerische Sterbetafeln 1929/32 für die Stadt- und Landbevölkerung, nach Zivilstandsgruppen, für Lungentuberkulose und Krebs: vom Eidgenössischen Statistischen Amt. Die schweizerische Wirtschaft im Krieg: *E. Speiser*.

#### INTERNATIONAL—

##### *International Labour Review*—

- May 1942—Juvenile employment in Germany: The policy of the Government. The war and merchant seamen, I.
- June 1942—Migrant labour in Africa and its effects on tribal life: *Margaret Read*. The war and merchant seamen, II.

## LIST OF ADDITIONS TO THE LIBRARY

Since the issue of Part I, 1942, the Society has received the publications enumerated below:—

## I.—OFFICIAL PUBLICATIONS

## (a) United Kingdom

*Colonial Office.* Colonial Development Advisory Committee. Eleventh and final report covering the period 1st April, 1939–17th July, 1940. London: H.M.S.O., 1941. Cmd. 6298.  $9\frac{1}{2}" \times 6"$ . 16 pp. 3d.

*Health, Ministry of.*

Current trend of population in Great Britain. London: H.M.S.O., 1942. Cmd. 6358.  $9\frac{1}{2}" \times 6"$ . 12 pp. 2d.

The prevalence and control of scabies. London: H.M.S.O., 1942. Cmd. 6355.  $9\frac{1}{2}" \times 6"$ . 4 pp. 1d.

*Medical Research Council.* Chronic pulmonary disease in South Wales coalminers, I.—Medical studies. A. Report by the Committee on Industrial Pulmonary Disease. B. Medical survey, by P. D'Arcy Hart and E. A. Aslett . . . C. Pathological report, by T. H. Belt . . . (Special report series No. 243). London: H.M.S.O., 1942.  $9\frac{1}{2}" \times 6"$ . xiv + 222 pp. 10s. 6d.

*Parliament.* The organisation for joint planning. London: H.M.S.O., 1942. Cmd. 6351.  $9\frac{1}{2}" \times 6"$ . 4 + 1 pp. 1d.

*Production, Ministry of.* Report of the committee on regional boards. London: H.M.S.O., 1942. Cmd. 6360.  $9\frac{1}{2}" \times 6"$ . ii + 29 pp. 6d.

*Scottish Education Department.* Summary report on education in Scotland for the years 1939 and 1940. Edinburgh: H.M.S.O., 1941. Cmd. 6317.  $9\frac{1}{2}" \times 6"$ . 24 pp. 4d.

*Select Committee on National Expenditure.* Session 1941–42. Reports: 9th. 8 pp. 2d. 10th. 12 pp. 2d. London: H.M.S.O., 1942.  $9\frac{1}{2}" \times 6"$ . 2 parts.

*Trade, Board of.*

Final report on the fifth census of production and the Import Duties Act Inquiry 1935. Part IV. [Advance proofs.] London, 1942.  $20" \times 8\frac{1}{2}"$ . 264 fols. (From the Statistical Department, Board of Trade.)

Retail Trade Committee. Third report. Concentration in the retail non-food trades. London: H.M.S.O., 1942.  $9\frac{1}{2}" \times 6"$ . 38 pp. 9d.

Utility knitted goods. Provisional schedule B: Knitted cloths, knitted garments, knitted gloves and key to non-utility group numbers. London: H.M.S.O., 1942.  $8\frac{1}{2}" \times 5\frac{1}{2}"$ . 41 pp. 9d.

*Treasury.*

An analysis of the sources of war finance and an estimate of the national income and expenditure in 1938, 1940, and 1941. London: H.M.S.O., 1942. Cmd. 6347.  $9\frac{1}{2}" \times 6"$ . 20 pp. 4d.

Family allowances; memorandum by the Chancellor of the Exchequer. H.M.S.O., 1942. Cmd. 6354.  $9\frac{1}{2}" \times 6"$ . 11 pp. 2d.

*Works and Buildings, Ministry of.* Second report of the Committee on the Brick Industry. London: H.M.S.O., 1942.  $9\frac{1}{2}" \times 6"$ . 28 pp. 6d.

## (b) British Empire

**Palestine—**

*Office of Statistics.* Statistics of foreign trade for the year ended 31st December, 1940. . . . Jerusalem: 1942.  $9\frac{1}{2}" \times 7"$ . 274 pp. 5s.

## (c) Foreign Countries

**Argentina—**

*Dirección General de Estadística de la Nación.* Estadística industrial de 1939. Resultados del relevamiento practicado al 31. de diciembre de 1939. Buenos Aires, 1942.  $11" \times 8\frac{1}{2}"$ . xiv + 449 pp.

**Portugal—**

*Instituto Nacional de Estatística.* Anuário estatístico: Ano de 1940. Apêndice ao capítulo xiv (Império Colonial) Lisboa, 1942.  $10\frac{1}{2}" \times 7\frac{1}{4}"$ . 160 pp.

## Switzerland—

*Edgenössisches statistisches Amt.* Neue schweizerische Sterbetafeln. (Beiträge zur schweizerischen Statistik- Heft 10). Bern, 1942.  $9\frac{1}{2}" \times 6\frac{3}{4}"$ . 56 pp.

## (d) International

## League of Nations —

Bulletin of the health organisation. Vol. ix, 1940–41. Nos. 1–4. Geneva, 1940–41.  $9\frac{1}{2}" \times 6"$ . 4 parts.

## II.—AUTHORS AND MISCELLANEOUS

- Butler (C. G.) and Finney (D. J.).* The influence of various physical and biological factors of the environment on honeybee activity: an examination of the relationship between activity and solar radiation. (Reprint from *Journal of Experimental Biology*, Vol. XVIII, No. 3, pp. 206–12, Jan. 1942.)  $10" \times 7"$ .
- Cart de Lafontaine (H. P.).* National planning and re-development. (Design for Britain Series, 6.) London: Dent, 1942.  $8\frac{1}{2}" \times 5\frac{1}{2}"$ . 31 pp. 6d.
- Catlin (George).* Anglo-American union as a nucleus of world federation. London: Macmillan, 1942.  $7\frac{1}{2}" \times 5"$ . 40 pp. 6d.
- Clark (Colin).* The economics of 1960. London: Macmillan, 1942.  $8\frac{1}{2}" \times 5\frac{1}{2}"$ . x + 118 pp. 8s. 6d.
- Comrie (L. J.) and Hartley (H. O.).* Table of Lagrangian coefficients for harmonic interpolation in certain tables of percentage points. (From *Biometrika*, Vol. XXXII, Part 11, Oct. 1941.)  $10\frac{1}{2}" \times 7\frac{1}{4}"$ . [4 pp.]
- Davey (Reginald).* Measurement of trees. Nutley, Sussex: Forest Press, 1942.  $9\frac{1}{2}" \times 6"$ . 236 pp. 21s.
- Douglas (F. C. R.).* Rating and taxation in the housing scene. (Design for Britain Series, 8.) London: Dent, 1942.  $8\frac{1}{2}" \times 5\frac{1}{2}"$ . 30 pp. 6d.
- Erdely (E. V.).* Prague braves the hangman. London: "The Czechoslovak," 1942.  $7" \times 5"$ . 126 pp.
- Finney (D. J.).* The detection of linkage: II. Further mating types; scoring of Boyd's data. (Reprint from *Annals of Eugenics*, Vol. 11, Part I, pp. 10–30, 1941.)  $10" \times 7"$ .
- The detection of linkage: III. Incomplete parental testing. (Reprint from *Annals of Eugenics*, Vol. 11, Part II, pp. 115–35, 1941.)  $9\frac{1}{2}" \times 7\frac{1}{2}"$ .
- The joint distribution of variance ratios based on a common error mean square. (Reprint from *Annals of Eugenics*, Vol. 11, Part II, pp. 136–40, 1941.)  $9\frac{1}{2}" \times 7\frac{1}{2}"$ .
- The relationship of plant number and yield in sugar-beet and mangolds. (Reprint from the *Empire Journal of Experimental Agriculture*, Vol. IX, No. 33, Jan. 1941.)  $10" \times 7"$ .
- Wireworm populations and their effect on crops. (Reprint from *Annals of Applied Biology*, Vol. XXVIII, No. 3, pp. 282–95, Aug. 1941.)  $10" \times 7"$ .
- The analysis of toxicity tests on mixtures of poisons. (Reprint from *Annals of Applied Biology*, Vol. XXIX, No. 1, pp. 82–94, Feb. 1942.)  $10" \times 7"$ . (From the author.)
- Goodfellow (David M.).* Tyneside: the social facts. 2nd ed. Newcastle-upon-Tyne: Co-operative Printing Soc., 1941.  $8\frac{1}{2}" \times 5\frac{1}{4}"$ . 100 pp. 1s.
- Greenwood (Major).* Medical statistics from Graunt to Farr. III. The statistical work of Graunt. (Reprint from *Biometrika*, April 1942.)  $10\frac{1}{2}" \times 7\frac{1}{2}"$ . [203–25 pp.] (From the author.)
- Gumbel (E. J.).* Simple tests for given hypotheses. (Reprint from *Biometrika*, April 1942.)  $10\frac{1}{2}" \times 7\frac{1}{2}"$ . [pp. 17–33]
- Haberler (Gottfried).* Consumer instalment credit and economic fluctuations. (Financial Research Program. Studies in Consumer Instalment Financing, 9.) New York: Nat. Bur. of Econ. Res., 1942.  $9" \times 6"$ . xix + 239 pp. \$2.50.
- Joad (C. E. M.).* An old countryside for new people. (Design for Britain Series, 2.) London: Dent.  $8\frac{1}{2}" \times 5\frac{1}{2}"$ . 31 pp. 6d.
- Jones (Harry J.).* Industrial background of housing. (Design for Britain Series, 7.) London: Dent.  $8\frac{1}{2}" \times 5\frac{1}{2}"$ . 31 pp. 6d.
- Lanchester (Henry Vaughan).* Post-war homes. (Design for Britain Series, 12.) London: Dent.  $8\frac{1}{2}" \times 5\frac{1}{2}"$ . 30 pp. 6d.
- Kuczynski (Jürgen).* Löhne und Ernährungskosten in Deutschland 1820 bis 1937. Libau: Gottl. D. Meyer, 1937.  $9\frac{1}{4}" \times 6\frac{1}{4}"$ . 45 pp. (From the author.)

- Lamb (Sir Horace).** An elementary course of infinitesimal calculus. 3rd edit. Cambridge University Press, 1942.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . xiv + 530 pp. 18s.
- Liga Vizcaina de Productores.** Catálogo de productos metalúrgicos de Vizcaya. Bilbao: Liga Vizcaina de Productores, 1942.  $11\frac{1}{4}'' \times 8\frac{1}{2}''$ . [176 pp.]
- Mannin (Ethel).** Castles in the street. (Design for Britain Series, 15.) London: Dent.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . 30 pp. 6d.
- Narain (Brij).** The curve of population. (Supplement to *Sanatana Dharma College Magazine* for March 1942.) Lahore: The Ripon Press, 1942.  $9\frac{1}{4}'' \times 7\frac{1}{2}''$ . 27 pp.
- National Institute of Economic and Social Research.** First analysis of budgets and spending interviews in Leeds. Feb.-Apr. 1942. [Charles Madge.] London, 1942.  $13'' \times 8''$ . 23 pp.
- Pearson (E. S.) and Hartley (H. O.).** New tables of statistical variables: (1) The probability integral of the range in samples from a normal population. (2) The percentage points of the range. (3) The percentage points of the  $t$  distribution. (Reprint from *Biometrika*, April 1942.) London: *Biometrika* Office, 1942.  $10\frac{1}{4}'' \times 7\frac{1}{2}''$ . [12 pp.] 2s. 6d.
- Robinson (Philip).** National companies. Chesterfield: Broomhead Bros., 1942.  $5\frac{1}{2}'' \times 4\frac{1}{2}''$ . 36 pp. 3d. (From the author.)
- Schneider (Otto).** Sobre un parámetro usado para la caracterización de distribuciones estadísticas bidimensionales. (*Anales de la Sociedad Científica Argentina*, Mayo 1942.) Buenos Aires, 1942.  $10\frac{1}{2}'' \times 6\frac{1}{2}''$ . [5 pp.]
- Selver (Paul).** Czechoslovak literature. London: Allen & Unwin, 1942.  $7\frac{1}{4}'' \times 5''$ . 56 pp. 2s. 6d.
- Simon (Leslie E.).** An engineers' manual of statistical methods. New York: John Wiley, 1941. (London: Chapman & Hall.)  $9\frac{1}{2}'' \times 6\frac{1}{2}''$ . ix + 231 pp. 7 charts. 16s. 6d.
- Smithsonian Institution.** Origin of the far eastern civilizations: a brief handbook by *Carl Whitting Bishop*. (War Background Studies, No. 1.) Washington, 1942.  $9'' \times 6''$ . 1 Plate. 53 pp.
- The evolution of nations by *John R. Swanton*. (War Background Studies, No. 2.) Washington, 1942.  $9'' \times 6''$ . 23 pp.
- Soutar (M. S.), Wilkins (E. H.) and Florence (P. Sargent).** Nutrition and size of family: report on a new housing estate, 1939. Prepared for the Birmingham Social Survey Committee. London: Allen & Unwin, 1942.  $7\frac{1}{2}'' \times 5''$ . 50 pp. 2s. 6d.
- The Statesman's yearbook: statistical and historical annual of the states of the world for the year 1942; edited by M. Epstein.** London: Macmillan, 1942.  $7'' \times 5''$ . xxxvii + 1474 pp. 30s.
- Stevens (W. L.).** Accuracy of mutation rates. (Reprint from *Journal of Genetics*, pp. 301-7, Apr. 1942.)  $10'' \times 7''$ .
- Steed (F. Streeton).** Cottages and countrymen. (Design for Britain Series, 11.) London: Dent.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . 30 pp. 6d.
- Sturzenegger (E.).** The Rand gold mines. 12th annual edition, 1942. London: Sturzenegger, 1942.  $6\frac{1}{2}'' \times 4\frac{1}{2}''$ . 285 pp. 25s.
- Thompson (Catherine M.).** Tables of percentage points of the incomplete beta-function and of the  $\chi^2$  distribution. . . . (Reprint from *Biometrika*, Oct. 1941.) London: *Biometrika* Office, 1941.  $11'' \times 7\frac{1}{2}''$ . [41 pp.] 4s.
- Wald (Abraham).** On the principles of statistical inference. Four lectures delivered at the University of Notre Dame, Feb. 1941. (Notre Dame Mathematical Lectures, Number 1.) Notre Dame: Indiana, 1942.  $9'' \times 6''$ . 47 pp.
- Webb (J. P.).** Signposts of building society finance. (Design for Britain Series, 1.) London: Dent.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . 29 pp. 6d.
- Wilson (Thomas).** Fluctuations in income and employment: with special reference to recent American experience and post-war prospects. (London School of Economics and Political Science, Studies in Economics and Commerce, No. 8.) London: Pitman, 1942.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . 213 pp. 18s.
- Zürcher Kantonalbank.** 72 Rechenschaftsbericht über das Jahr 1941: Dem Kantonsrat des Kantons Zürich erstattet vom Bankrat. Zürich, 1942.  $10\frac{1}{2}'' \times 8\frac{1}{2}''$ . 47 pp.

## REGISTRATION OF THE UNITED KINGDOM

## No. I.—ENGLAND AND WALES

A.—BIRTHS, DEATHS, and MARRIAGES: *Numbers and Annual Rates per 1,000 persons living. Deaths under 1 year of age: Mortality per 1,000 Live Births in the Calendar Years 1937–1941 and in the Quarters of those years.*

Years	1937		1938		1939		1940 *		1941 *	
Estimated Mid-Year Popln. in thousands	41,031		41,215		41,160					
	Number	Rate	Number	Rate	Number	Rate	Number	Rate ‡	Number	Rate ‡
Live Births ...	610,557	14.9	621,204	15.1	619,352	14.9	607,029	14.6	586,778	14.2
Stillbirths ...	24,806	0.60	24,729	0.60	24,309	0.59	22,731	0.55	20,985	0.51
Deaths ...	509,574	12.4	478,829	11.6	499,804	12.1	581,537	14.0	534,643	12.9
Marriages ...	359,160	8.8	361,768	8.8	439,694	10.6	468,267	11.3	387,510	9.3
Infant Mortality ...	34,917	58	32,473	53	30,927	50	33,638	55	34,292	58
Quarters										
Live Births in the Quarters of each Calendar Year										
Jan.-Mar. ...	145,405	14.4	155,187	15.3	153,382	15.0	154,345	15.0	147,020	14.4
Apr.-June ...	163,777	16.0	164,179	16.0	164,306	15.9	166,686	16.2	147,246	14.2
July-Sept. ...	158,590	15.3	158,082	15.2	161,023	15.4	149,092	14.3	147,406	14.1
Oct.-Dec. ...	112,785	13.8	143,756	13.8	140,641	13.5	136,906	13.1	145,106	13.9
Stillbirths										
Jan.-Mar. ...	6,268	0.62	6,185	0.61	6,295	0.62	6,223	0.60	5,615	0.55
Apr.-June ...	6,619	0.65	6,639	0.65	6,362	0.62	5,994	0.58	5,474	0.53
July-Sept. ...	6,000	0.58	6,072	0.58	5,946	0.57	5,371	0.52	5,009	0.48
Oct.-Dec. ...	5,919	0.57	5,833	0.56	5,706	0.55	5,143	0.49	4,887	0.47
Deaths (excluding Stillbirths) †										
Jan. Mar. ...	163,716	16.2	137,897	13.6	154,232	15.1	205,183	19.9	178,647	17.5
Apr. June ...	118,525	11.6	119,188	11.6	120,529	11.7	119,706	11.6	139,891	13.5
July Sept. ...	100,301	9.7	102,545	9.9	103,300	9.9	111,733	10.7	101,337	9.7
Oct.-Dec. ...	127,032	12.3	119,199	11.5	121,743	11.6	144,916	13.9	114,768	11.0
Marriages										
Jan.-Mar. ...	70,700	7.0	52,159	5.1	47,121	4.6	108,792	10.5	80,719	7.9
Apr.-June ...	80,265	7.8	102,290	9.9	102,816	9.9	116,134	11.2	105,200	10.2
July-Sept. ...	121,421	11.7	116,559	11.2	152,930	14.6	131,254	12.6	104,333	10.0
Oct.-Dec. ...	86,774	8.4	90,760	8.7	136,827	13.2	112,087	10.7	97,258	9.3
Infant Mortality										
Jan.-Mar. ...	10,636	7.3	10,523	6.8	9,978	6.5	11,876	7.7	10,985	7.5
Apr.-June ...	8,835	5.4	7,933	4.8	7,828	4.8	7,681	4.6	8,712	5.9
July-Sept. ...	6,795	4.3	6,510	4.1	6,358	4.0	6,316	4.3	6,411	4.3
Oct.-Dec. ...	8,651	6.1	7,477	5.2	6,763	4.9	7,765	5.7	8,184	5.6

\* Provisional figures.

† Excluding deaths of non-civilians after 2 Sept., 1939.

‡ Provisional rates based upon Mid-1939 population. Changes in total population since 1939 are not sufficient to invalidate these rates to any serious extent



## No. II.—SCOTLAND

**BIRTHS, DEATHS, and MARRIAGES: Numbers and Annual Rates per 1,000 persons living. Deaths under 1 year of age: Mortality per 1,000 Live Births in the Calendar Years 1937–1941 and in the Quarters of those years.**

Years	1937		1938		1939 *		1940 *		1941 *	
Estimated Mid-Year Popln. in thousands	4,979		4,985		5,010					
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Live Births ...	87,810	17.6	88,627	17.7	86,899	17.4	86,403	17.3	89,743	17.9
Stillbirths ...	Not separately recorded				3,832	42	3,796	42	3,689	39
Deaths ...	68,942	13.9	62,953	12.6	64,413	12.9	72,775	14.5	72,558	14.5
Marriages ...	38,351	7.7	38,747	7.8	46,257	9.2	53,597	10.7	47,717	9.5
Infant Mortality ...	7,050	80	6,163	70	5,955	69	6,766	78	7,426	83
Quarters										
Live Births in the Quarters of each Calendar Year										
Jan.–Mar. ...	21,589	17.6	22,245	18.1	21,429	17.4	22,113	17.8	22,254	18.0
Apr.–June ...	23,864	19.2	23,909	19.3	23,615	18.9	23,298	18.7	23,423	18.8
July–Sept. ...	21,746	17.3	21,423	17.0	21,549	17.1	21,154	16.8	22,656	18.0
Oct.–Dec. ...	20,612	16.4	20,960	16.7	20,306	16.1	19,838	15.8	21,410	17.0
Stillbirths										
Jan.–Mar. ...	—	—	—	—	958	43	1,017	44	1,034	44
Apr.–June ...	—	—	—	—	979	40	958	39	958	39
July–Sept. ...	—	—	—	—	990	44	917	42	867	37
Oct.–Dec. ...	—	—	—	—	905	43	904	44	830	37
Deaths (excluding Stillbirths)										
Jan.–Mar. ...	22,123	18.0	17,448	14.2	18,995	15.4	25,936	20.8	23,332	18.9
Apr.–June ...	16,781	12.7	15,603	12.5	15,672	12.6	16,002	12.9	18,999	15.2
July–Sept. ...	13,616	10.9	13,807	11.0	13,587	10.8	14,209	11.3	14,464	11.5
Oct.–Dec. ...	17,422	13.9	16,095	12.8	16,159	12.8	16,628	13.2	15,763	12.5
Marriages										
Jan.–Mar. ...	8,089	6.6	7,885	6.4	7,682	6.2	12,005	9.6	10,754	8.7
Apr.–June ...	9,359	7.5	9,430	7.6	9,960	8.0	12,971	10.4	12,383	9.9
July–Sept. ...	11,511	9.2	11,893	9.4	15,620	12.4	15,625	12.4	13,078	10.4
Oct.–Dec. ...	9,375	7.5	9,518	7.6	13,015	10.3	12,996	10.3	11,502	9.1
Infant Mortality										
Jan.–Mar. ...	2,104	97	1,790	80	1,890	88	2,474	112	2,435	109
Apr.–June ...	1,733	73	1,563	65	1,442	61	1,568	67	1,965	84
July–Sept. ...	1,299	60	1,233	58	1,220	57	1,215	57	1,424	63
Oct.–Dec. ...	1,914	93	1,577	75	1,403	69	1,509	76	1,602	75

\* Provisional figures.

† Based upon estimated population, Mid-1939.

## No. III.—NORTHERN IRELAND

**BIRTHS, DEATHS, and MARRIAGES:** *Numbers and Annual Rates per 1,000 persons living. Deaths under 1 year of age: Mortality per 1,000 Live Births in the Calendar Years 1937–1941 and in the Quarters of those years.*

Years	1937		1938		1939		1940		1941 *	
Estimated Mid-Year Popln. in thousands	1,281		1,286		1,295		1,296		1,288	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Live Births ... ..	25,412	19.8	25,743	20.0	25,240	19.5	25,363	19.6	26,906	20.9
Stillbirths ... ..	Not separately recorded									
Deaths ... ..	19,282	15.1	17,649	13.7	17,542	13.5	18,941	14.6	19,641	15.2
Marriages ... ..	8,623	6.73	8,617	6.70	9,185	7.09	9,795	7.5	11,928	9.2
Infant Mortality ...	1,969	7.7	1,933	7.5	1,779	7.7	2,179	8.6	2,057	7.6
Quarters	Live Births in the Quarters of each Calendar Year									
Jan.–Mar. ... ..	6,308	19.7	6,286	19.6	6,231	19.3	6,467	20.0	6,206	19.3
Apr.–June ... ..	6,917	21.6	6,902	21.5	6,859	21.2	7,094	21.9	7,232	22.5
July–Sept. ... ..	6,444	20.1	6,515	20.3	6,340	19.6	6,334	19.5	7,087	22.0
Oct.–Dec. ... ..	5,743	17.9	6,040	18.8	5,821	18.0	5,490	16.9	6,381	19.8
	Deaths (excluding Stillbirths).									
Jan.–Mar. ... ..	6,796	21.2	5,153	16.0	5,350	16.5	6,597	20.4	6,183	19.3
Apr.–June ... ..	4,514	14.1	4,283	13.3	4,371	13.5	4,594	14.3	5,753	17.9
July–Sept. ... ..	3,603	11.3	3,799	11.8	3,686	11.4	3,759	11.6	3,741	11.6
Oct.–Dec. ... ..	4,369	13.6	4,416	13.7	4,142	12.8	3,991	12.3	3,985	12.4
	Marriages									
Jan.–Mar. ... ..	1,790	5.6	1,599	5.0	1,432	4.4	2,104	6.5	2,099	6.5
Apr.–June ... ..	1,913	6.0	2,229	6.9	2,209	6.8	1,979	6.1	3,033	9.4
July–Sept. ... ..	2,688	8.3	2,602	8.1	2,559	7.9	2,976	9.2	3,837	11.9
Oct.–Dec. ... ..	2,232	6.6	2,157	6.7	2,637	8.1	2,541	7.8	2,959	9.2
	Infant Mortality									
Jan.–Mar. ... ..	616	9.8	668	10.6	599	9.6	689	10.7	563	9.1
Apr.–June ... ..	496	7.2	455	6.6	448	6.5	601	8.5	518	7.2
July–Sept. ... ..	370	5.7	368	5.6	346	5.5	481	7.6	467	6.6
Oct.–Dec. ... ..	482	8.4	436	7.2	381	6.7	403	7.3	509	8.0

\* Preliminary figures.

## No. IV.—EIRE

**BIRTHS, DEATHS, and MARRIAGES:** *Numbers and Annual Rates per 1,000 persons living. Deaths under 1 year of age: Mortality per 1,000 Live Births in the Calendar Years 1937-1941 and in the Quarters of those years.*

Years	1937		1938		1939		1940		1941 *	
Estimated Mid-Year Popln. in thousands	2,948		2,937		2,934		2,958		2,990	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Live Births ... ..	56,488	19·2	56,925	19·4	56,070	19·1	56,594	19·1	56,710	19·0
Stillbirths ... ..					Not separately recorded					
Deaths ... ..	45,086	15·3	40,041	13·6	41,717	14·2	41,885	14·2	43,823	14·7
Marriages ... ..	14,780	5·0	14,893	5·1	15,204	5·2	15,212	5·1	15,122	5·1
Infant Mortality ...	4,121	7·3	3,794	6·7	3,691	6·6	3,759	6·6	4,123	7·3
Quarters										
Live Births in the Quarters of each Calendar Year										
Jan.-Mar. ... ..	13,554	18·4	14,083	19·2	14,245	19·4	14,084	19·0	13,678	18·3
Apr.-June ... ..	15,052	20·4	14,697	20·0	14,475	19·7	15,134	20·5	14,946	20·0
July-Sept. ... ..	15,008	20·4	14,768	20·1	14,262	19·4	14,385	19·5	15,056	20·1
Oct.-Dec. ... ..	12,874	17·5	13,377	18·2	13,088	17·8	12,991	17·6	13,030	17·4
Deaths (excluding Stillbirths)										
Jan.-Mar. ... ..	15,360	20·8	11,442	15·6	13,313	18·1	13,361	18·1	14,648	19·6
Apr.-June ... ..	11,206	15·2	9,814	13·4	10,372	14·1	10,481	14·2	11,328	15·1
July-Sept. ... ..	8,617	11·7	8,587	11·7	8,600	11·7	8,442	11·4	8,683	11·6
Oct.-Dec. ... ..	9,903	13·5	10,198	13·9	9,432	12·9	9,601	13·0	9,164	12·3
Marriages										
Jan.-Mar. ... ..	3,303	4·5	3,824	5·2	3,487	4·8	3,503	4·7	3,554	4·8
Apr.-June ... ..	3,717	5·0	3,435	4·7	3,665	5·0	3,808	5·1	3,724	5·0
July-Sept. ... ..	4,202	5·7	4,379	6·0	4,514	6·2	4,592	6·2	4,223	5·6
Oct.-Dec. ... ..	3,558	4·8	3,255	4·4	3,538	4·8	3,309	4·5	3,621	4·8
Infant Mortality										
Jan.-Mar. ... ..	1,260	9·1	1,155	8·1	1,173	8·2	1,103	7·8	1,137	8·3
Apr.-June ... ..	1,095	7·1	946	6·4	932	6·4	954	6·3	1,066	7·1
July-Sept. ... ..	893	6·0	810	5·5	754	5·3	735	5·1	964	6·4
Oct.-Dec. ... ..	908	6·9	883	6·6	832	6·4	967	7·5	956	7·3

\* Provisional figures.

## No. V.—GREAT BRITAIN AND IRELAND

SUMMARY OF BIRTHS, DEATHS, AND MARRIAGES in the years 1938–1941: *Numbers and Rates per 1,000 persons living. Deaths under 1 year of age: Mortality per 1,000 Live Births.*

(Compiled from the Quarterly Returns of the respective Registrars-General)

	England and Wales	Scotland	Northern Ireland	United Kingdom	Eire
Area in statute acres (thousands) ...	37,340	9,462	3,488	50,290	17,254
1938					
Population (in thousands) ...	41,215	4,993	1,286	47,494	2,937
Births ...	621,204	88,627	25,742	735,573	56,925
Birth rates ...	15.1	17.7	20.0	15.5	19.4
Deaths ...	478,829	62,953	17,649	559,431	40,041
Death rates ...	11.6	12.6	13.7	11.8	13.6
Marriages ...	361,768	38,747	8,617	409,132	14,893
Marriage rates ...	8.7	7.8	6.7	8.6	5.1
Deaths under 1 year ...	32,473	6,163	1,933	40,569	3,794
Infant Mortality rates ...	53	70	75	55	67
1939					
Population (in thousands) ...	41,460	5,006	1,295	47,761	2,934
Births ...	619,352	86,899	25,240	731,491	56,070
Birth rates ...	14.9	17.4	19.5	15.3	19.1
Deaths ...	499,804	64,413	17,542	581,759	41,717
Death rates ...	12.1	12.9	13.5	12.2	14.2
Marriages ...	439,694	46,257	9,185	495,136	15,204
Marriage rates ...	10.6	9.2	7.1	10.3	5.2
Deaths under 1 year ...	30,927	5,955	1,779	38,661	3,691
Infant Mortality rates ...	50	69	70	53	66
1940					
Population (in thousands) ...	41,460 *	5,010 *	1,296	47,766	2,958
Births ...	607,029	86,403	25,363	718,795	56,594
Birth rates ...	14.6	17.3	19.6	15.0	19.1
Deaths ...	581,537	72,775	18,941	673,253	41,885
Death rates ...	14.0	14.9	14.6	14.0	14.2
Marriages ...	468,267	53,597	9,795	531,659	15,212
Marriage rates ...	11.3	10.6	7.5	11.1	5.1
Deaths under 1 year ...	33,638	6,766	2,179	42,583	3,769
Infant Mortality rates ...	55	78	86	59	66
1941					
Population (in thousands) ...	41,460 *	5,010 *	1,288	47,758	2,990
Births ...	586,778	89,743	26,906	703,427	56,710
Birth rates ...	14.2	17.9	20.9	14.7	19.0
Deaths ...	534,643	72,558	19,641	626,842	43,823
Death rates ...	12.9	14.5	15.2	13.1	14.7
Marriages ...	387,510	47,717	11,928	447,155	15,122
Marriage rates ...	9.3	9.5	9.2	9.4	5.1
Deaths under 1 year ...	34,292	7,426	2,051	43,769	4,123
Infant Mortality rates ...	58	83	76	62	73

\* Mid-1939 estimate. See No. 1, England and Wales (footnote).

# ROYAL STATISTICAL SOCIETY.

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# JOURNAL

## OF THE ROYAL STATISTICAL SOCIETY

### PART III, 1942.

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THE EXPENDITURE OF 1,360 BRITISH MIDDLE-CLASS HOUSEHOLDS IN 1938-39

By PHILIP MASSEY

(Read before the ROYAL STATISTICAL SOCIETY, June 16th, 1942, the PRESIDENT,  
SIR WILLIAM BEVERIDGE, K.C.B., in the Chair)

IN 1938-39 an enquiry was undertaken by the Civil Service Statistical and Research Bureau in order to obtain information as to the family expenditure of public officials in Great Britain. The enquiry was undertaken on behalf of the following organizations: the Staff Side of the National Whitley Council for the Administrative and Legal Departments of the Civil Service and the Civil Service Joint Consultative Committee, the National Association of Local Government Officers and the London County Council Staff Association, the National Union of Teachers and the Educational Institute of Scotland. It covered, therefore, the great proportion of organized public officials in Britain.

The principal object was to obtain, from public officials in receipt of salaries of over £250 a year, material showing the distribution of family expenditure, on a basis comparable with that of the official enquiry undertaken by the Ministry of Labour, covering working-class households. The results yield much information on other matters besides.

#### *Scope of the Enquiry*

It was estimated that the organizations concerned had approximately 190,000 members in receipt of salaries exceeding £250 a year, and it is considered that the information obtained must be broadly representative, not only of the membership of these organizations, but also of the middle-class, and in particular of salary-earners, as a whole.

It was felt that 1,500 to 2,000 effective replies in each week of enquiry should be aimed at, with the object of obtaining 1,000 to 1,500 households supplying budgets for all the four weeks of enquiry. It was known that of the estimated 190,000 receiving over £250 a year, many would be ineligible (see below), a proportion out of any sample would refuse to participate, and some would agree to take part but would not keep their undertaking. A 1 in 25 sample was therefore used; the maximum number of participants which this method could have produced was in the neighbourhood of six thousand. The number of members who promised to participate was 3,433, a very satisfactory result indeed.

#### *Choosing of Members to be Approached*

The method of carrying out the sampling was necessarily somewhat complicated owing to the variation, between the different organizations taking part, in the numbers earning over £250 a year. These complications arose principally in connection with the Civil Service organizations. In the Local

Government Officers' and Teachers' organizations the proportion of members with salary over £250 was between one-quarter and one-half; Civil Servants, however, are organized in numerous Associations, many of which have very small memberships. In general, the larger Associations contain smaller proportions of members earning over £250 and the smaller Associations contain larger proportions of such members. But the actual *number* of Civil Servants earning over £250 in the few moderately large Associations is much greater than in the large number of small Associations. It was decided, on the Civil Service side, to approach 20 Associations: those with only a small proportion of members receiving over £250 were not asked to participate. One of the selected Associations, however, found it impossible to take part. There were therefore 23 Associations participating—19 Civil Service, 2 Local Government Officers' and 2 Teachers'. This method secured that about 80 per cent. of the Civil Servants organized in Associations and receiving salaries of more than £250 a year came within the ambit of the Enquiry.

Associations in which the majority, or all, of the members were receiving salaries of over £250 were asked to prepare, if these were not already available, lists of members in alphabetical or numerical order and to mark off to be approached the 25th, 50th, 75th, 100th, etc., members on their list or lists. This could be done either at the headquarters of the Association or through its branches, as convenient. Where a list contained less than 25 names, the first in alphabetical order was to be marked off to be approached.

The Branch Secretary (or Headquarters) then approached each marked person and asked in the first place whether his or her salary, at April 1st, 1938, exceeded £250 a year. If not, the member *before* on the list (*after* only in lists of less than 25 names) was to be approached instead. In the second place, provided the member's salary exceeded £250, he was to be asked whether he was willing to assist in the Enquiry by completing the necessary forms.

In Associations containing a minority of members receiving over £250 (the big Associations all fell in this category, and these had by far the greater *number* of eligible members) the procedure adopted was slightly different in practice, though in principle the same. It would have been wasteful of time for lists of all members to have been prepared when more than half would be ineligible on the criterion of salary. In such cases, therefore, the Branch Secretaries (or Associations) were asked first of all to prepare a list of members in receipt of over £250. It was emphasized that it was not necessary to aim at doing this exactly, for example by asking for information individually at this stage. What was important was to reduce the full list of members by cutting out those who it was known were not receiving over £250, retaining all persons about whom there might be doubt. Thus a list was obtained of members mainly or wholly in receipt of over £250, and thereafter the same method was followed as described above.

#### *Approaches to Members*

Members were approached personally wherever possible. It was arranged that, having ascertained that the member was in receipt of a salary exceeding £250 on April 1st, 1938, the Branch Secretary should explain the object of the Enquiry, and that it was necessary that the forms should be filled in by those on whom the lot had fallen by chance. The member was to be assured of the absolute confidentiality of individual returns. He was then to be asked if he

would be willing to supply information relating to a week's family expenditure on that basis.

It was laid down, as already described, that the Branch Secretary should make substitutions for persons who proved to be outside the scope of the Enquiry because their salary was £250 or less, but that he should not make substitutions on account of refusals to supply information. Moreover, information was not required from any person who was a lodger living with another family and paying an inclusive charge for rent and food, or who was living as part of the household of a parent whose name was not on the list of persons to be approached, or from households which included lodgers (not related to the family) who were provided with meals, but substitutions were not to be made on these accounts. Persons living alone, or paying rent as lodgers and making their own arrangements as to food, *were* asked to supply information. These arrangements were the same as those made in the working-class enquiry conducted by the Ministry of Labour.

The Branch Secretary was asked to make a return to his Association showing: (1) the number of persons in his Branch who were chosen to be approached, and, of these, (a) the number refusing to supply information, (b) the number who were lodgers or were living as part of the household of a parent, (c) the number whose households included lodgers provided with meals, (d) the number who would be away from home during the whole of the first week of enquiry (these were not eligible to participate—in subsequent weeks the substitution of a later week was provided for), (e) the number willing and eligible to supply information, and (2) a schedule of the names and addresses of those in (e) indicating the forms which each would require.

There is no reason to suppose that there was any substantial departure from the principle of random sampling and of no substitution on account of refusals, though it is known that in some instances the zeal of Branch Secretaries outran discretion in that some substitutions were made where refusals were met with in the first instance.

#### *The Three Forms of Enquiry*

The Branch Secretary was asked to inform each willing and eligible member that he (the member) would receive, through his Association, a copy of the main form of enquiry. He was asked to emphasize to him the need for careful study of the form in advance of the week of enquiry, and to recommend him to persuade every member of his family to take an interest in the Enquiry and to put down on separate paper every expenditure during the week, however small or large or otherwise peculiar or unusual, in order that these should be included in the household's total statement of expenditure.

It was recognized that in some cases certain members of the household might be unwilling to include their expenditure in the general statement, and would prefer to make a separate account of their own expenditure to be returned direct. This was provided for, as in the official working-class enquiry. The Branch Secretary was requested to ask each person undertaking to fill in a main form of enquiry whether any member of his household would be likely to be unwilling to disclose his expenditures to the member of his household who would fill in the main form. Where a personal expenditure form was required, the Branch Secretary was to make a note of the fact for the purposes of the schedule returned to his Association.

Since expenditure on clothing is very irregular, it was decided to adopt the same procedure as in the working-class enquiry conducted by the Ministry of



Labour and to obtain records of clothing expenditure weekly for a whole year. In the middle-class enquiry, however, a proportionately greater number of clothing records was aimed at, and obtained. All persons eligible and willing to supply information on the main form were asked if they would be willing also to give information as to expenditure on clothing covering a whole year. The returns made to Associations also indicated which members were willing to do this. For the four weeks of enquiry the main form was used for clothing, as for all other, expenditure; for the remaining 48 weeks of the year the special clothing form was used.

#### *Distribution of Forms and Confidentiality of Returns of Expenditure*

From the returns received from Branch Secretaries the 23 participating Associations compiled statements of requirements of forms; these statements were forwarded to the Bureau. The Bureau supplied the forms, each main form carrying a reference number; the Associations were responsible for entering on the personal and clothing forms the reference number corresponding to that on the main form which went to the member concerned.

The front page of the main form of enquiry for the first week contained the following assurance of confidentiality:—

“The persons to whom this enquiry is directed have been selected by a ‘random sample’ method and have indicated their willingness to supply information along the lines indicated in these forms of enquiry. In this way it is hoped to obtain figures which will be representative of the whole body of public officials.

“You have been invited to co-operate in this matter and have expressed your willingness to do so, and it is hoped that you will keep the necessary records for a week in the first instance, and for four weeks in the end, and give the details asked for on the forms.

“All information given will be treated as *strictly confidential*. Particulars respecting individual households will not be published or disclosed in any way. You are not asked to give your name or address anywhere on the form. Your Association will know that you are filling in a form, but it will not see it when completed; the Civil Service Statistical & Research Bureau will see the details on the form, but it will not know who has filled these in.”

It was asked that forms of enquiry should be sent direct to the Bureau by post. The system of reference numbers enabled the pledge of confidentiality to be carried out. In cases where it was desired to communicate with an individual participating in the Enquiry, a letter was written which was addressed to the member by his reference number, and sent under cover to the Association concerned; the Association deleted the reference number, substituted the appropriate name and address by referring to records which were not at any stage forwarded to the Bureau, and sent the communication to the member without opening it. The member replied direct to the Bureau, and there was no necessity for him to sign his name or give his address; the reference number was all that was required.

#### *The Four Weeks of Enquiry*

Since expenditure on certain articles varies between different parts of the year, it was decided, in the official working-class enquiry, to obtain information

for four separate weeks at quarterly intervals. The same procedure was followed. This middle-class enquiry was held six months after the working-class enquiry, the first week being the same as the third week of the working-class enquiry—April 24th to 30th, 1938. Subsequent weeks were chosen at different parts of the months; these were: July 3rd to 9th, October 9th to 15th, and January 15th to 21st, 1939.

For the second and subsequent weeks of enquiry provision was made for households who would be away from home in the week selected. It was arranged that details should be furnished for the next week but one following return home.

### *The Enquiry Forms*

The enquiry forms were based upon those used by the Ministry of Labour, by permission of His Majesty's Stationery Office. The principal additions were a question relating to the Income of the Head of the Family and questions as to *Annual Expenditure* on Education and Income Tax, for which it was felt that weekly expenditure figures would be unreal, even when averaged out over a large body of households supplying budgets. There were a number of technical alterations; in particular, it was felt unnecessary to ask for food expenditure to be set out day by day and this section was rearranged accordingly.

The main form of enquiry asked for particulars, in addition to those just previously mentioned, of:—

(i) the composition of the household—sex and age (if under 18) of each person and his or her relationship to head of household, and the occupation and industry of each wage- or salary-earner;

(ii) housing—rent or purchase payments, rates and water charges, ground rent, the number of rooms in the house or dwelling (not counting scullery or bathroom), the number of rooms let (if any) and the rent received for those rooms;

(iii) food expenditure—quantity and cost of each item bought during the week;

(iv) gas and electricity expenditure—expenditure during the week in the case of those who had a slot meter, during the period covered by the last account for other households;

(v) garden, allotment, etc., produce;

(vi) fuel and light (other than gas and electricity), clothing and other expenditures—a list of the main items being provided, with space for “other expenditure this week.”

There was an introductory page of guidance, a long list of items of expenditure not separately specified on the form, with direction as to the appropriate heads under which such items should be entered, and a space for notes to be entered if any member of the household was absent from home for the whole or part of the week, and of any other exceptional circumstances which affected the household expenditure during the week.

The arrangements made as regards “personal” forms have already been described.

As regards clothing, this Enquiry broadly followed the methods of the official enquiry, but *all* persons who said they were willing to fill in a main form were also asked if they would fill in clothing forms for a year, and about two-thirds of those who agreed to take part in the main enquiry also agreed to take

part in the clothing enquiry. The number of effective participants in the clothing enquiry, however, was only about one-half of the number of effective participants in the main enquiry.

*The Response to the Enquiry*

It can be seen from Table I that 3,433 households agreed to take part in the main enquiry and 2,351 households to take part in the clothing enquiry. The

TABLE I  
*Numbers Undertaking to Participate in the Enquiry*

	Main Enquiry	Clothing Enquiry
Civil Servants ... ..	1,109	938
Local Government Officers ... ..	1,003	471
Teachers ... ..	1,321	942
Total ... ..	3,433	2,351

number undertaking to participate, as regards main forms, totalled 45 per cent. of the theoretical maximum of 7,600 (one-twenty-fifth of 190,000) and 57 per cent. of the estimated practical maximum of six thousand. [The practical maximum would be reduced below the theoretical maximum not only by the exclusion of ineligible persons, but also by the exclusion of Civil Servants who were members of Associations with only a very small number or proportion of members receiving salaries of over £250 a year. The loss of all the fractions of 25 on the lists used for the random sampling would be offset, perhaps somewhat more than offset, by the taking of *one* name from lists of less than 25 persons.]

The number of budgets received was 2,480 in the first week of enquiry, 1,891 in the second week, 1,786 in the third week, and 1,660 in the fourth week. The budgets in general were filled in carefully and accurately so far as the amounts of expenditure were concerned. On quantities, however, the information supplied was in many cases inadequate. This, however, was only a possible by-product of the Enquiry, and was therefore dropped, so far as any attempt to obtain comprehensive figures covering the whole of the effective participants was concerned. It would have been possible to have obtained figures from a large selection of the budgets, but the number which would have had to be put aside on this criterion would have been far greater than the number which were defective from the standpoint of expenditure-distribution. Altogether, 189 of the budgets were found to be ineligible for tabulation, since they had been

TABLE II  
*Number of Budgets Received*

	Number of Budgets Received	Ineligible	Rejected	Number Eligible and Effective
First Week of Enquiry ... ..	2,480	57	85	2,338
Second Week of Enquiry ... ..	1,891	74	40	1,777
Third Week of Enquiry ... ..	1,786	33	31	1,722
Fourth Week of Enquiry ... ..	1,660	25	28	1,607
Total ... ..	7,817	189	184	7,444

supplied by persons who were lodgers or from households containing lodgers, away from home, under the income limit, etc., and 184 had to be rejected as unfit for tabulation, leaving 7,444 eligible and effective budgets. The figures are shown by weeks of enquiry in Table II.

The total number of persons undertaking to supply budgets was 3,433. For the First Week of Enquiry, therefore, the return was 72 per cent. and the eligible and effective return 68 per cent.; for the Second Week the corresponding figures were 55 and 52 per cent.; for the Third Week 52 and 50 per cent.; for the Fourth Week 48½ and 47 per cent. Broadly speaking, after the First Week, for which the response was a good deal higher than had been expected in organising the Enquiry, the ratio settled down at one-half. Since nearly three-fifths of the estimated practical maximum number of participants had undertaken to supply budgets, this means that nearly three persons in ten out of this practical maximum (estimated at six thousand) supplied budgets for the Second, Third and Fourth Weeks, and a much higher proportion for the First Week.

The Enquiry was carried out over four separate weeks to eliminate seasonal variations in expenditure and obtain a true average of expenditure throughout the year. It is obvious that the budgets received from households which supplied budgets for all the four Weeks of Enquiry were of much greater value than those from households which missed one or more weeks.

Table III shows, for each Week of Enquiry, the number of budgets in these two categories. The figures for Civil Servants, Local Government Officers and Teachers (referred to henceforward as the "Industrial Groups") are shown separately.

TABLE III  
*Number of Eligible and Effective Budgets Received*

	First Week	Second Week	Third Week	Fourth Week
Civil Servants:				
All-Fours ... ..	436	436	436	436
Non-Fours ... ..	356	151	103	78
Total ... ..	792	587	539	514
Local Government Officers:				
All-Fours ... ..	449	449	449	449
Non-Fours ... ..	292	135	111	60
Total ... ..	741	584	560	509
Teachers:				
All-Fours ... ..	475	475	475	475
Non-Fours ... ..	330	131	148	109
Total ... ..	805	606	623	584
All Industrial Groups:				
All-Fours ... ..	1,360	1,360	1,360	1,360
Non-Fours ... ..	978	417	362	247
Total ... ..	2,338	1,777	1,722	1,607

The number of participants who supplied budgets for all four weeks was 1,360, equal to 40 per cent. of those who originally undertook to participate

and 23 per cent. of the estimated number who could have participated (*i.e.*, of what has been called the practical maximum). The figures both for the "all-fours" and the "non-fours" have been tabulated, but final averages have been based exclusively upon the budgets supplied by the "all-fours." It was apparent from the analysis of the budgets that the "non-fours" were much less reliable, particularly those who gave up after the first week.

The figures which follow relate, therefore, to the 1,360 participants who provided four budgets each and formed 40 per cent. of the number who originally undertook to provide information for the purposes of the Enquiry.

### *Classification of Effective Budgets*

The whole of the eligible and effective budgets were classified as follows:—

(1) Into the three Industrial Groups—Civil Servants, Local Government Officers, Teachers;

(2) Within each Industrial Group into twelve Income Groups (Income of Head of Family)—eleven £50 groups from £250 a year up to but not including £800, the incomes of £800 and over forming the twelfth group;

(3) Within each Income Group into the "All-Four" and "Non-Four" Groups (*i.e.*, those budgets received for all four weeks of enquiry and those not);

(4) Within the "All-Four" Group (but not within the "Non-Four" Group) into the Household Groups, of which there were six—1, 2, 3, 4, 5 and 6 & over.

For the calculation of the figures of average expenditure, etc., presented in this report the number of income groups was reduced to four, and the household groups within each income group were amalgamated. The very detailed breakdown just described was never intended to be used as it stood; but having been tabulated in this way the figures can be brought together in other groupings if required.

### *The Income and Household Groups*

The Enquiry was concerned with persons in receipt of salaries exceeding £250, but for determining the income group into which a household should be placed the whole income of the head of the family was used. It was considered better to ask for this information than for the family income, for three reasons: (1) it was much more likely to be answered correctly; (2) any attempt to measure family income would raise a great many difficulties in regard to intra-household payments; (3) it is probable that for middle-class households the income of the head, and not the family income, is the determining factor in the way of life of the family, since additional earners will generally be earning much less than the head of the family, and in most cases will not remain as earners in the household for more than a limited period.

The income group was determined by the annual income of the head of the family as returned for the first week of enquiry. The figures given later for the average income of head of family within each income group are the averages of the figures stated for the four weeks. The same applies in regard to the household groups: the number in household in the first week determines the grouping, but the figures for number in household within each income group are averages for the four weeks.

Table IV shows the number of households in each industrial group analysed

TABLE IV

*Numbers supplying Budgets for all Four Weeks of Enquiry, by Income Groups of Head of Family and Household Groups*

Number in Household					Income Group 1, Over £250 and up to £350	Income Group 2, £350 and up to £500	Income Group 3, £500 and up to £700	Income Group 4, £700 and over	All Income Groups
<b>Civil Servants:</b>									
1	...	...	...	...	2	—	—	—	2
2	...	...	...	...	45	27	16	9	97
3	...	...	...	...	50	42	36	14	142
4	...	...	...	...	30	31	37	15	113
5	...	...	...	...	10	15	17	11	53
6 and over	...	...	...	...	9	7	5	8	29
Total	...	...	...	...	146	122	111	57	436
<b>Local Government Officers:</b>									
1	...	...	...	...	3	1	1	—	5
2	...	...	...	...	57	27	6	—	90
3	...	...	...	...	79	59	12	3	153
4	...	...	...	...	57	63	9	—	129
5	...	...	...	...	28	19	2	2	51
6 and over	...	...	...	...	8	7	4	2	21
Total	...	...	...	...	232	176	34	7	449
<b>Teachers:</b>									
1	...	...	...	...	35	6	—	—	41
2	...	...	...	...	85	61	8	—	154
3	...	...	...	...	70	59	13	—	142
4	...	...	...	...	25	54	13	3	95
5	...	...	...	...	5	23	6	—	34
6 and over	...	...	...	...	—	6	1	2	9
Total	...	...	...	...	220	209	41	5	475
<b>All Industrial Groups:</b>									
1	...	...	...	...	40	7	1	—	48
2	...	...	...	...	187	115	30	9	341
3	...	...	...	...	199	160	61	17	437
4	...	...	...	...	112	148	59	18	337
5	...	...	...	...	43	57	25	13	138
6 and over	...	...	...	...	17	20	10	12	59
Total	...	...	...	...	598	507	186	69	1,360

by major income groups (over £250 and up to £350, £350 and up to £500, £500 and up to £700, £700 and over) and household groups.

The 1,360 participants supplying budgets for all four weeks fall into twelve major groups. Averages were calculated for these twelve groups, and also for each industrial group as a whole and each major income group as a whole. The number of participants in each of these groups is shown in Table V.

It should be noted that 57 of the 69 households in the highest income group are Civil Servant households, and that of the 48 one-person households 40 are in the lowest income group and 35 of these (and also 6 of the 8 one-person households in the other three income groups) are Teachers.

TABLE V

*Numbers supplying Budgets for all Four Weeks : Income Groups (of Head of Family)*

	Income Group 1, Over £250 and up to £350	Income Group 2, £350 and up to £500	Income Group 3, £500 and up to £700	Income Group 4, £700 and over	Total of Industrial Group
Civil Servants ... ..	146	122	111	57	436
Local Government Officers ... ..	232	176	34	7	449
Teachers ... ..	220	209	41	5	475
Total ... ..	598	507	186	69	1,360

(In subsequent tables, for the sake of convenience, the four income groups are entitled simply £250–350, £350–500, £500–700, and £700 and over.)

#### *Analysis of the Budgets*

The budgets were analysed in great detail; the results for the four income groups, separately and together, are shown in the main table at the end of this report. The Ministry of Labour was consulted in regard to the methods adopted in the official working-class enquiry, and parallel methods were followed. In certain respects, however, it was found desirable to carry the analysis of the middle-class budgets into more detail than that of the Ministry's working-class budgets.

#### *Composition of Households*

The average number of persons per household over the whole of the 1,360 households from which budgets were received for all four weeks was approximately  $3\frac{1}{4}$ , of whom  $2\frac{1}{4}$  were eighteen years of age or over. About  $\frac{1}{4}$  of a person per household was aged fourteen and under eighteen,  $\frac{1}{2}$  of a person was aged five and under fourteen, and  $\frac{1}{4}$  of a person consisted of a child under five. There were considerable differences between the income groups; the total number in household ranged from just under 3 in the lowest group to just under 4 in the highest. (See Table VI and, for division by sex, Table XXII.)

TABLE VI

*Composition of Households and Number of Earners*

	Income of Head of Family				
	£250–350	£350–500	£500–700	£700 and over	All
Average Number of Persons per Household aged:					
18 and over ... ..	2·10	2·27	2·47	2·89	2·26
14 and under 18 ... ..	0·12	0·28	0·39	0·35	0·23
5 and under 14 ... ..	0·43	0·61	0·57	0·59	0·52
under 5 ... ..	0·33	0·23	0·13	0·14	0·26
All Ages ... ..	2·98	3·39	3·56	3·97	3·27
Average Number of Wage- or Salary-Earners ... ..	1·17	1·25	1·26	1·30	1·22

The number of earners per household was a little less than  $1\frac{1}{2}$ , which contrasts very sharply with  $1\frac{3}{4}$  for working-class households. In this there was not much difference between the income groups, particularly after the first. (Domestic servants were not reckoned as earners in the household.)

### *Housing*

Of the total number of households (1,360), 35 per cent. were renting their dwellings,  $46\frac{1}{2}$  per cent. were buying their dwellings, and rather over 18 per cent. had bought and wholly paid for their dwellings. Only five households (less than  $\frac{1}{2}$  per cent.) were provided by their employers with dwellings rent-free.

In Income Group 4 the proportion who had bought and wholly paid for their dwellings was well above the average, but the proportion renting was also well above average: this may be attributed to the fact that a considerable number of the persons in this income group are from a section of the Civil Service which is liable to official transfer. Leaving aside Income Group 4, the other three show with increasing income a steady but not very big increase in the percentage who had bought their homes, and a corresponding decrease in the percentage renting. The proportion in process of buying their homes, if the highest income group is left out of account, remains almost constant at just below one-half.

The proportion who had bought and wholly paid for their homes was a good deal higher for the teachers than for the civil servants or the local government officers, the percentage being 19 for civil servants, 10 for local government officers, and 25 for teachers. The percentage buying their homes was 44 for civil servants,  $60\frac{1}{2}$  for local government officers, and  $35\frac{1}{2}$  for teachers. The percentage renting was 37 for civil servants, 29 for local government officers, and  $38\frac{1}{2}$  for teachers.

The average net weekly payments for rent, rates and water charges, by those who were renting their dwellings, was 18s. 10 $\frac{1}{4}$ d. in the first income group, 19s. 8 $\frac{1}{4}$ d. in the second, 26s. 5 $\frac{1}{4}$ d. in the third, 41s. 5d. in the fourth, and 21s. 5 $\frac{1}{4}$ d. for all households in this category. The average net weekly payments made by those who were buying or had bought their dwellings, for purchase instalments, etc., ground rent, rates and water charges, was 19s. 1 $\frac{1}{2}$ d. in the first income group, 20s. 5 $\frac{1}{4}$ d. in the second, 25s. 5 $\frac{1}{4}$ d. in the third, 30s. 0d. in the fourth, and 21s. 0 $\frac{3}{4}$ d. for all households in this category.

Two points of interest emerge from these figures. The first is that, both for households renting and for households buying or owning, there is only a small increase in the payments made by those in the second income group as compared with those in the first income group. There are several possible explanations of this. Children between five and eighteen are more numerous in the second income group, so that some households in that group may be less well off economically than when the income was lower and the children were younger or had not yet been born. A second possible explanation is that there exists a sort of minimum middle-class rent, below which non-manual workers cannot find the accommodation they feel to be appropriate. A third possible explanation is that there is a demarcation, within the middle-class, at round about the £500 income level. Probably all these factors apply in some degree, and there may be others. This point may be worth pursuing in other investigations into middle-class ways of life. It would not be unreasonable, in the abstract, to assume that income of head of family was perhaps a less appropriate index



of general standard of living in the first income group than at higher levels. It was known that a number of women teachers, in particular, live in pairs. In such cases, where two incomes of about the same size are available for meeting the expenses of the household, the criterion "income of head of family" would not be satisfactory, and if the number of such cases, among those who returned effective budgets for all four weeks, had been considerable, this might have accounted for the closeness of the housing expenditure in the first and second income groups. In fact, however, the number of such households in the teachers group, where most would occur, was about a dozen, so their effect would be very slight. Furthermore, the ratio of total expenditure to income of head of family in the first income group is only fractionally higher than it is in the second.

The second noteworthy point in the above figures of housing expenditure is that in each income group except the highest, the average payments for housing are very similar for "renters" and for "owners or buyers." It must be emphasized that it is owners or buyers—the figure for buyers alone would presumably be appreciably higher. It can be taken that one reason for the rather low figure of 30s. 0d. for owners or buyers in the top income group (where renters spend 41s. 5d.) is that in this group, of the owners and buyers, the owners form nearly one-half, whereas they form only about one-quarter in the first income group and between one-quarter and one-third in the second and third income groups.

The average net weekly expenditure on rent or purchase of dwelling, ground rent, rates and water charges over all the 1,360 households, including the very small number who were provided with dwellings rent-free, was 21s. 1½d.—the figures for the four income groups being respectively 19s. 0d., 20s. 0½d., 25s. 9d. and 34s. 10½d. The average net number of rooms occupied was 5·5—the figures for the income groups being 5·1, 5·6, 6·0 and 7·6.

Table VII shows the average net weekly expenditure per household on rent or purchase, etc., by industrial and income groups. The number of households in each group has been given in Table V.

TABLE VII  
*Average Net Weekly Housing Expenditure*

	Income of Head of Family									
	£250-350		£350-500		£500-700		£700 and over		All	
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Civil Servants ... ..	19	7½	22	1½	27	10½	35	8¾	24	6½
Local Government Officers ... ..	20	0½	21	10¾	26	3	37	2¾*	21	6
Teachers ... ..	17	6	17	3	19	5¾	21	5½†	17	7
All Industrial Groups ... ..	19	0	20	0½	25	9	34	10½	21	1½

\* Average of only 7 households.

† Average of only 5 households.

### *Food*

The average weekly expenditure on food, over the 1,360 households, was 41s. 10d. This includes meals away from home, but excludes both alcoholic

and "soft" drinks and also food for animals, etc. These are excluded throughout this section. Total food therefore means including meals away from home but excluding these three items; food excluding meals away excludes these three items as well.

Table VIII shows food expenditure by income groups. It must be remembered, in considering the increased expenditure by the higher income-group households, that these households contain more persons. Food ex-

TABLE VIII  
*Average Weekly Expenditure per Household on Food*

	Income of Head of Family				
	£250-350	£350-500	£500-700	£700 and over	All
	s. d.	s. d.	s. d.	s. d.	s. d.
Food (excluding meals, etc., away from home) ...	33 2½	39 0¾	46 0	52 0¼	38 1¼
Meals, etc., away from home ...	2 4¼	3 0½	6 7¼	12 6½	3 8¾
Total Food ...	35 6¾	42 1¼	52 7¼	64 6¾	41 10

penditure per head increases a good deal less steeply than does food expenditure per household. So far as expenditure other than on meals away from home is concerned Table IX shows the figures in terms of per head food expenditure.

TABLE IX  
*Average Food Expenditure per Head (excluding meals, etc., away from home)*

	Income of Head of Family				
	£250-350	£350-500	£500-700	£700 and over	All
Food Expenditure (excluding meals, etc., away from home) ...	33s. 2¼d.	39s. 0¾d.	46s. 0d.	52s. 0¼d.	38s. 1¼d.
Number in Household ...	2·98	3·39	3·56	3·97	3·27
Food Expenditure per Head (excluding meals, etc., away from home) to nearest penny	11s. 2d.	11s. 6d.	12s. 11d.	13s. 1d.	11s. 8d.

Two things may be noted: (1) that the food expenditures per head show only a very small increase between the first and second income groups, and that the figures for the third and fourth income groups are also very similar; (2) that there is not a great deal of difference between the whole of the four groups.

It is apparent from Table VIII that the inclusion of meals away from home would increase considerably the difference between the groups, since the top income group spends, per household, more than four times as much on meals away as the second income group and more than five times as much as the first income group. Table X is on the same basis as Table IX, but includes meals away from home. It is doubtful, however, whether Table X gives a better index of the position from the nutritional standpoint, since the expenditure of the same amount of money involves considerably less food in a restaurant than in the home.

TABLE X  
*Average Food Expenditure per Head (including meals, etc., away from home)*

	Income of Head of Family				
	£250-350	£350-500	£500-700	£700 and over	All
Food Expenditure (including meals, etc., away from home)	35s. 6½d.	42s. 1¼d.	52s. 7¼d.	64s. 6¾d.	41s. 10d.
Number in Household ... ..	2·98	3·39	3·56	3·97	3·27
Food Expenditure per Head (including meals, etc., away from home) to nearest penny	11s. 11d.	12s. 5d.	14s. 9d.	16s. 3d.	12s. 10d.

Before drawing conclusions from these tables it would be desirable to re-express the averages of food expenditure in terms of equivalent man-value, since the proportion of children in the various categories differs considerably between income groups. Such an analysis would take up far too much space in this report, the purpose of which is to analyse the distribution of expenditure, but it would be a valuable by-product of the Enquiry.

The distribution of expenditure between groups of food items is given in Table XI. The items comprised in each group, and the average expenditures on each item, are given in the main table at the end of this report.

TABLE XI  
*Average Weekly Expenditure per Household on Food, by Groups of Items*

	Income of Head of Family				
	£250-350	£350-500	£500-700	£700 and over	All
	s. d.	s. d.	s. d.	s. d.	s. d.
Bread, Cereals and Related Products ... ..	4 6	5 2½	5 10½	6 7½	5 0¾
Meat and Fish ... ..	8 8½	10 7	12 6½	14 7½	10 3
Dairy Foods, etc. ... ..	10 0½	11 6	13 4½	14 8½	11 3
Tea, Coffee and Cocoa ... ..	1 6½	1 9	1 10½	2 1½	1 8½
Sugar and Preserves ... ..	1 4½	1 7½	1 11	2 2½	1 7
Vegetables ... ..	2 4	2 8½	3 2½	3 9	2 8
Fruit ... ..	2 11½	3 7½	4 10	5 2	3 7½
Other Food (excluding meals, etc., away from home) ...	1 8	2 0	2 5½	2 9½	1 11½
Total (excluding meals away) ...	33 2½	39 0½	46 0	52 0½	38 1½
Meals, etc., away from home ...	2 4½	3 0½	6 7½	12 6½	3 8½
Total Food ... ..	35 6½	42 1½	52 7½	64 6¾	41 10

The main thing which emerges from this table is the uniformity of expenditure-distribution between the groups. For every group of food items the expenditure per household increases with increasing income. The top income group spends 1·57 times as much on food (excluding meals, etc., away from home) as the lowest income group, the highest ratio being 1·75 for fruit and the lowest ratio being 1·37 for tea, coffee and cocoa (combined). The full list of these ratios is set out in ascending order in Table XII.

It must be remembered, for groups of items or for individual items, just as

TABLE XII  
*Comparison of Food Expenditure in Income Groups 1 and 4*

	Average for Income Group 4 divided by Average for Income Group 1
Household Expenditure on:	
Tea, Coffee and Cocoa ... ..	1.37
Dairy Foods, etc. ... ..	1.46
Bread, Cereals and Related Products ... ..	1.47
Sugar and Preserves ... ..	1.58
Vegetables ... ..	1.61
Other Food (excluding meals away) ... ..	1.67
Meat and Fish ... ..	1.68
Fruit ... ..	1.75
Total Food (excluding meals away) ... ..	1.57
Number in Household ... ..	1.33

for food as a whole, that the average number of persons in household is roughly 4 in the top income group as against only 3 in the first income group (more precisely—3.97 against 2.98), so that if expenditure did not go up at least in this proportion (*i.e.*, by one-third) the expenditure per head would be actually less in the top group. This does not happen for any *group* of food items, though for tea, coffee and cocoa (combined) the expenditure per head is only slightly higher in the top group than it is in the first group. For tea alone, however, expenditure per head is less in the top group than in the first group, and for cocoa household expenditure is actually lower. For tea, coffee and cocoa combined these decreases are outweighed by the rapid increase in expenditure on coffee with increased income.

It is apparent from Tables XI and XII that there is little difference between the income groups in the percentages of food expenditure (leaving aside meals away from home) on the eight groups of food items. The percentages are shown in Table XIII.

TABLE XIII  
*Average Weekly Expenditure per Household on Food, by Groups of Items : Percentages*

	Income of Head of Family				
	£250-350	£350-500	£500-700	£700 and over	All
	per cent.	per cent.	per cent.	per cent.	per cent.
Bread, Cereals and Related Products ... ..	13.6	13.4	12.7	12.7	13.3
Meat and Fish ... ..	26.3	27.1	27.2	28.1	26.9
Dairy Foods, etc. ... ..	30.3	29.4	29.1	28.3	29.5
Tea, Coffee and Cocoa ... ..	4.7	4.5	4.1	4.1	4.5
Sugar and Preserves ... ..	4.2	4.2	4.2	4.3	4.2
Vegetables ... ..	7.0	7.0	6.9	7.2	7.0
Fruit ... ..	8.9	9.3	10.5	9.9	9.5
Other Food (excluding meals, etc., away from home) ... ..	5.0	5.1	5.3	5.4	5.1
Total (excluding meals away)	100.0	100.0	100.0	100.0	100.0

Households were asked to state the quantity of eggs, vegetables and fruit, and other produce, produced at home or on the allotment and consumed in the household during the weeks of enquiry. Out of the 1,360 households, the average number which obtained an addition to their fruit or vegetable supplies in this way, over the four weeks of enquiry, was 360. The numbers for the respective weeks were as follows: April week, 246; July, 465; October, 464; January, 265. Other produce, apart from eggs, was negligible, and the figure for eggs was equal to an average of only one-quarter of an egg per household per week over the whole of the 1,360 households.

### *Clothing*

As already mentioned, the same method was adopted in regard to clothing as in the official working-class enquiry. A special clothing enquiry was carried out, by means of which information as to weekly expenditure over a whole year was obtained from those who were willing to undertake this additional task. 706 of the 1,360 households which supplied effective budgets for all four weeks of enquiry supplied also effective sets of clothing forms for a whole year. This is so large a proportion that there could be little doubt that the results would be representative. Table XIV shows the income and household groups into which the 706 effective clothing enquiry participants fell. Comparable figures for the main enquiry, from Table IV, are repeated here for convenience.

TABLE XIV

*Number of Clothing Enquiry Effective Participants, and Numbers supplying Main Enquiry Budgets for all Four Weeks: by Income and Household Groups*

Number in Household	Main Enquiry					Clothing Enquiry				
	Income Groups					Income Groups				
	1	2	3	4	All	1	2	3	4	All
1 ... ..	40	7	1	—	48	14	4	—	—	18
2 ... ..	187	115	30	9	341	99	60	13	8	180
3 ... ..	199	160	61	17	437	103	89	31	9	232
4 ... ..	112	148	59	18	337	44	86	40	10	180
5 ... ..	43	57	25	13	138	21	27	16	7	71
6 and over	17	20	10	12	59	8	8	4	5	25
Total ...	598	507	186	69	1,360	289	274	104	39	706

The average number of persons per household, in the households which supplied effective sets of clothing forms for a whole year, was 3·26 (in the first week of enquiry). In the main enquiry the average number of persons per household was 3·27.

The results of the Clothing Enquiry are shown in Table XV.

The averages of four weeks' expenditure returned by the whole of the 1,360 "main enquiry" participants are shown in Table XVI.

The discrepancy between the averages yielded by the two enquiries is due presumably to a tendency to include on the main forms some items of clothing expenditure incurred a little before the weeks of enquiry. The average expenditure on clothing by the 706 clothing enquiry participants in the four weeks of

TABLE XV

*Average Weekly Expenditure per Household on Clothing*  
(*Clothing Enquiry: 52 weeks*)

	Income of Head of Family									
	£250-350		£350-500		£500-700		£700 and over		All	
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Men's clothing and materials ...	3	0 $\frac{3}{4}$	4	2 $\frac{1}{2}$	5	9 $\frac{3}{4}$	7	4	4	1 $\frac{1}{2}$
Women's clothing and materials	5	6 $\frac{1}{2}$	5	9 $\frac{1}{2}$	7	10 $\frac{3}{4}$	11	9 $\frac{1}{2}$	6	4
Children's clothing and materials	1	3 $\frac{1}{2}$	2	4	3	1 $\frac{1}{2}$	3	1 $\frac{1}{4}$	2	0 $\frac{3}{4}$
Boots and shoes ...	1	7 $\frac{3}{4}$	1	11	2	4 $\frac{1}{2}$	2	10	1	11
Clothing repairs, cleaning and dyeing ...	0	3 $\frac{1}{2}$	0	4	0	5	0	7 $\frac{1}{2}$	0	4
Repairs to boots and shoes ...	0	7 $\frac{1}{2}$	0	9 $\frac{1}{4}$	0	10 $\frac{1}{4}$	0	11 $\frac{1}{2}$	0	9
Total ...	12	5	15	4	20	5 $\frac{1}{4}$	26	7 $\frac{1}{2}$	15	6 $\frac{1}{4}$

TABLE XVI

*Average Weekly Expenditure per Household on Clothing*  
(*Main Enquiry: 4 weeks*)

	Income of Head of Family									
	£250-350		£350-500		£500-700		£700 and over		All	
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Men's clothing and materials ...	4	10 $\frac{3}{4}$	6	9 $\frac{1}{2}$	9	5 $\frac{1}{2}$	8	9 $\frac{1}{2}$	6	5
Women's clothing and materials	8	1	8	10 $\frac{3}{4}$	11	0 $\frac{1}{2}$	12	9 $\frac{1}{2}$	9	0 $\frac{1}{2}$
Children's clothing and materials	1	11 $\frac{1}{4}$	3	1	3	10 $\frac{1}{2}$	5	6	2	9 $\frac{3}{4}$
Boots and shoes ...	2	5 $\frac{3}{4}$	3	0	3	2 $\frac{1}{2}$	3	10 $\frac{3}{4}$	2	10
Clothing repairs, cleaning and dyeing ...	0	5 $\frac{1}{2}$	0	6 $\frac{1}{2}$	0	8	1	1 $\frac{3}{4}$	0	6 $\frac{1}{2}$
Repairs to boots and shoes ...	1	0 $\frac{1}{2}$	1	3 $\frac{1}{4}$	1	3 $\frac{3}{4}$	1	7 $\frac{1}{4}$	1	2 $\frac{1}{4}$
Total ...	18	10 $\frac{1}{2}$	23	7	29	6 $\frac{1}{4}$	33	8 $\frac{3}{4}$	22	10

enquiry alone came out at 20s. 3 $\frac{3}{4}$ d. It would appear, therefore, that these households, who were supplying weekly information, had less tendency to overstate expenditure in the weeks of enquiry than had those who supplied information for four weeks only, at quarterly intervals, but there is still a considerable discrepancy. It was notable that the clothing expenditure stated in the first week of enquiry was particularly high both for the clothing enquiry participants and the others.

There is no reason to believe that the clothing enquiry participants were not closely representative of the participants as a whole, and it seems reasonable, therefore, to take the results of the clothing enquiry as applicable to the participants as a whole. These figures have therefore been used in the main table at the end of this report.

The results of the clothing enquiry show an annual average household expenditure of about £32 in Income Group 1, £40 in Income Group 2, £53

in Income Group 3, £69 in Income Group 4. The average over all households is rather over £40.

Of the total weekly expenditure on clothing about 27 per cent. was spent on men's, 41 per cent. on women's, and 13 per cent. on children's clothing and materials: total 81 per cent. About 12 per cent. was spent on boots and shoes, apart from repairs, which accounted for another 5 per cent. The remaining 2 per cent. was spent on clothing repairs, cleaning and dyeing.

### *Fuel and Light*

The average weekly expenditure on fuel and lighting among the 1,360 households supplying budgets for all four weeks of enquiry was 10s. 1d.

For gas and electricity, where a slot meter was used the household was asked to state how much money had been put in the meter during the week, but in other cases details of the period and amount of the last account were asked for and the average weekly expenditures of the households were obtained from the information provided. Payments for meter rent, fittings, etc., are included under expenditure on gas and electricity.

Details of expenditure are given in the main table. Table XVII provides a summary.

TABLE XVII

*Average Weekly Expenditure per Household on Fuel and Light*

	Income of Head of Family				
	£250-350	£350-500	£500-700	£700 and over	All
	s. d.	s. d.	s. d.	s. d.	s. d.
Coal and coke ... ..	4 4½	5 5½	7 6½	8 6½	5 5
Gas and Electricity ... ..	3 5	3 10½	4 8½	6 11½	3 11½
Oil, and other fuel and light (fire-wood, candles, matches, etc.)	0 8½	0 9½	0 7½	0 8½	0 8½
Total ... ..	8 5½	10 1½	12 10½	16 2	10 1

Coal alone accounted for nearly half of the total expenditure on fuel and light, and coal and coke together accounted for rather more than half of the total.

### *Other Items*

Food, housing, clothing, and fuel and light account for only a little over half of the total expenditure of the 1,360 households. In the case of Income Groups 3 and 4, indeed, less than half of total expenditure falls under these four main heads, and more than half is spent on "other items."

These "other items" are arranged in the main table at the end of this report in small groups, as with food. But a satisfactory classification is more difficult to determine: some of the items are awkward to group. Groups A to H (see Table XVIII) are fairly satisfactory. The inclusion of subscriptions to Trade Unions, etc., in I is artificial, but the only alternatives would be to include the item under the final group (L), which would be unfortunate, since this group has a special significance, or to show it as an item by itself, which would be pointless, because it can be seen by itself in the main table. There is no par-

ticular justification for grouping together the items which are grouped in J and K, except that the only alternative would be to show each item separately. Items in Group L are those which it seemed worth tabulating separately for a middle-class enquiry, but which are not shown separately in the results of the working-class enquiry.\*

TABLE XVIII  
*Average Weekly Expenditure per Household on Other Items*

	Income of Head of Family									
	£250-350		£350-500		£500-700		£700 and over		All	
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
A. Household ... ..	10	10½	13	3½	16	9	21	0½	13	0½
B. Tobacco and Cigarettes ...	2	9½	3	3½	3	10½	4	3	3	2½
C. Travelling ... ..	4	1	5	5½	7	5½	14	5½	5	6½
D. Newspapers, Books, Stationery, Postages, etc. ...	3	3½	4	8½	7	4	12	6½	4	10
E. Entertainments ... ..	2	0	2	7	4	0½	5	2½	2	8
F. Education ... ..	0	10½	3	3½	7	11½	14	5½	3	5½
G. Hairdressing, etc., Chemists' Sundries, Laundry ...	2	6	2	10½	3	11½	5	11½	3	0½
H. Doctors' fees, etc., Medicines, Hospital Payments, etc. ...	4	11½	7	4½	8	10	12	5½	6	9
I. Insurance, Pensions, Trade Union, etc., subscriptions	10	5	15	10½	15	7½	13	10	13	4
J. Domestic Help, Licences, Holiday expenditure ...	3	7½	5	2½	9	9½	16	7½	5	8½
K. Drinks, and Food for Animals, etc. ... ..	1	6	2	1½	2	6½	6	0½	2	1½
L. Other ... ..	13	8½	19	8½	27	10½	52	7½	19	10½
Total Other Items ...	60	6½	85	9½	116	1½	179	6½	83	7

In every group of items except I (Insurance, Pensions, etc.) the expenditure shows a rise with each step of increased income. There is a special reason for the position in regard to the one exception. In the third income group Civil Servants account for about three-fifths of the households, and in the fourth income group for over four-fifths, and Civil Service pensions are non-contributory whereas Local Government Officers' and Teachers' pensions are contributory.

Education expenditure needs a special word. This was asked for on a weekly basis on the main form of enquiry, but a special question was also included as to annual expenditure, since it was realized that the figures obtained on a weekly basis might be unrepresentative. In fact, two of the four weeks of enquiry fell at a time when many school bills were being paid, and the figures on this basis were, indeed, far too high; the figures included in Table XVIII, and in the main table, are those resulting from the special question as to annual expenditure.

The expenditure on other items as a whole is almost three times as high in the top income group as in the lowest income group. The groups of items in which the rise is less than in this ratio are A, B, E, G, H and I. The groups of

\* *Ministry of Labour Gazette*, December 1940.



items in which the rise is more than in this ratio are C, D, F, J, K and L. This is probably just what one would expect, except perhaps in regard to C (travelling), where there is a big jump in expenditure in the top income group as compared with the third. The over-average increase in D is due to telephone expenditure; F is education (by itself); the over-average increase in J is entirely due to a very big rise in expenditure on domestic help, in K to a more than average rise in expenditure on alcoholic drinks, and in L mainly to motoring, etc., which in the top income group accounts for more than two-fifths of the total expenditure on group L items. Of the other fairly large items in group L, sports, games and other forms of exercise, allowances, religion and charity, and gifts, toys and children's pocket money all show an expenditure in the top income group more than three times as high as in the first.

A note should perhaps be added respecting holiday expenditure. In the first week of enquiry persons who would be away from home were ineligible. For subsequent weeks the following instruction appeared on the form of enquiry: "If you or your family will be away from home, owing to holidays, during the week . . . you are asked to give particulars for a later week and to alter the dates printed as necessary. You should let a week elapse between your return home and the week for which you give particulars." It was clearly desirable to provide in this way. Holiday expenditure is made up of expenditures on *items*—rent, food, amusements, etc.—which otherwise would be put under their appropriate heads, and it would be impossible to determine how to ask people to deal with these. If everything were put under "holidays," it would appear that the family ate no food during the week, smoked no cigarettes, and so on. If the items were placed according to what they *were*, then the expenditure would probably be of an unusual nature, but nothing at all would go down to "holidays." Besides, could one expect people to keep accounts when on holiday?

As a consequence, the averages given for "holiday expenditure" represent mainly brief holidays, probably in most cases by single members of the household, and do not purport to give any indication of what the families spend annually while on holiday.

#### *Summary of Total Expenditure*

The total weekly expenditure of the 1,360 households, by main groups of items, is given in Table XIX.

TABLE XIX

#### *Summary of Average Weekly Expenditure per Household on All Items*

	Income of Head of Family									
	£250-350		£350-500		£500-700		£700 and over		All	
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Food ... ..	35	6½	42	1½	52	7½	64	6¾	41	10
Housing ... ..	19	0	20	0½	25	9	34	10½	21	1½
Clothing ... ..	12	5	15	4	20	5½	26	7½	15	6½
Fuel and Light ... ..	8	5½	10	1½	12	10½	16	2	10	1
Other Items ... ..	60	6½	85	9½	116	1½	179	6½	83	7
Grand Total ... ..	135	11½	173	4½	227	9½	321	8½	172	1½

*Expenditure in Relation to Income*

It will be of value to compare these averages of total weekly expenditure with the average incomes of the heads of families. Income Tax was not an "item of expenditure" for the purposes of the Enquiry, but a special question was asked as to the annual amount paid. In Table XX this figure, converted to weekly terms, is deducted from the income of the head of the family (average of the figures stated for the four weeks) converted to weekly terms, and the result is compared with the figure of total expenditure. The number of wage- or salary-earners per household is shown at the foot of the table.

TABLE XX  
*Expenditure in Relation to Income (of Head of Family)*

	Income of Head of Family									
	£250-350		£350-500		£500-700		£700 and over		All	
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Total Expenditure per Week ...	135	11 $\frac{3}{4}$	173	4 $\frac{3}{4}$	227	9 $\frac{3}{4}$	321	8 $\frac{3}{4}$	172	1 $\frac{3}{4}$
Weekly Income of Head of Family	116	11	153	1	220	4 $\frac{1}{2}$	346	11	156	1 $\frac{3}{4}$
Deduct Income Tax per Week ...	1	2 $\frac{3}{4}$	2	6	10	5 $\frac{1}{2}$	32	11 $\frac{1}{4}$	4	6 $\frac{3}{4}$
Weekly Income less Income Tax	115	8 $\frac{1}{4}$	150	7	209	11 $\frac{1}{4}$	313	11 $\frac{3}{4}$	151	7
Total Expenditure per Week divided by										
Weekly Income less Income Tax	1·18		1·15		1·09		1·02		1·14	
Number of wage- or salary-earners ...	1·17		1·25		1·26		1·30		1·22	

It will be noted that the expenditure figures are in reasonably close accord with the incomes of heads of families (deducting Income Tax). Since only the income of the head of the family is included, it would not be expected that expenditure would be only equal to, or less than, that income. The proportionate excess of expenditure over income of head of family declines as one goes up the income groups, while the number of earners per family increases somewhat. But it would be reasonable to assume (a) that the additional earners in the lower income groups earned a good deal more in relation to the head of the family than they did in the higher income groups, and (b) that there was actually a fair amount of saving in the higher income groups.

*The Distribution of Total Expenditure*

It can be seen from Table XIX that the 1,360 middle-class households which provided information for the four weeks of enquiry spent, broadly, twice as much on food as on housing and twice as much on "other items" as on food. In Table XXI the summary of average expenditure, by income groups, is shown in percentage form.

TABLE XXI

*Summary of Average Weekly Expenditure per Household: Percentages*

	Income of Head of Family				
	£250-350	£350-500	£500-700	£700 and over	All
	Number of Households in Main Enquiry (all four weeks)				
	598	507	186	69	1,360
	per cent.	per cent.	per cent.	per cent.	per cent.
Food ... ..	26·2	24·3	23·1	20·1	24·3
Housing ... ..	14·0	11·6	11·3	10·8	12·3
Clothing ... ..	9·1	8·8	9·0	8·3	9·0
Fuel and Light ... ..	6·2	5·8	5·6	5·0	5·9
Other Items ... ..	44·5	49·5	51·0	55·8	48·5
Total ... ..	100·0	100·0	100·0	100·0	100·0

Expenditure on "other items" amounted to nearly half of the total, ranging from between 44 and 45 per cent. in the first income group to nearly 56 per cent. in the top income group. As between the lowest and highest income groups, expenditure on food fell from 26 per cent. to 20 per cent., on housing from 14 per cent. to 11 per cent., on clothing from 9 per cent. to 8 per cent., and on fuel and light from 6 per cent. to 5 per cent.

The 1,360 middle-class households as a whole distributed their expenditure approximately as follows: food, 24½ per cent.; housing, 12½ per cent.; clothing, 9 per cent.; fuel and light, 6 per cent.; other items, 48½ per cent.\*

\* The corresponding figures for the households of industrial, etc., workers covered by the official working-class enquiry were: food, 40 per cent.; housing, nearly 13 per cent.; clothing, between 9 and 10 per cent.; fuel and light, between 7 and 8 per cent.; other items, about 30 per cent. (*Ministry of Labour Gazette*, December 1940.)

**TABLE XXII**  
*Average Weekly Expenditure per Household by Items*

Key No.		Income of Head of Family				
		Over £250 and up to £350	£350 and up to £500	£500 and up to £700	£700 and over	All
1.	Number of Households supplying budgets for all four weeks ...	598	507	186	69	1,360
10.	Average Income of Head of Family ...	£304	£398	£573	£902	£406
<i>Average Number of Persons per Household</i>						
13.	Males 18 and over ...	0.89	1.04	1.15	1.21	1.00
14.	Males 14 and under 18 ...	0.05	0.17	0.16	0.04	0.11
15.	Males 5 and under 14 ...	0.22	0.32	0.31	0.26	0.27
16.	Males under 5 ...	0.18	0.12	0.08	0.08	0.14
17.	Females 18 and over ...	1.21	1.23	1.32	1.68	1.26
18.	Females 14 and under 18 ...	0.07	0.11	0.23	0.31	0.12
19.	Females 5 and under 14 ...	0.21	0.29	0.26	0.33	0.25
20.	Females under 5 ...	0.15	0.11	0.05	0.06	0.12
	Total Number in Household ...	2.98	3.39	3.56	3.97	3.27
12.	Number of wage- or salary-earners...	1.17	1.25	1.26	1.30	1.22
<i>Housing</i>						
		per cent.	per cent.	per cent.	per cent.	per cent.
21 (a).	Percentage of households who were renting their dwellings ...	36.5	34.1	29.7	42.4	35.0
21 (b).	Percentage of households provided by employers with dwellings rent-free ...	0.2	0.8	0.0	0.0	0.4
22 (a).	Percentage of households who were buying their dwellings ...	47.4	46.9	48.7	30.1	46.5
22 (b).	Percentage of households who had bought and wholly paid for their dwellings ...	16.0	18.2	21.6	27.5	18.2
26 (b).	Average Net Weekly Payments, by households who were renting their dwellings, for rent, rates and water charges ...	s. d. 18 10½	s. d. 19 8½	s. d. 26 5½	s. d. 41 5	s. d. 21 5½
27 (b).	Average Net Weekly Payments, by households who were buying or had bought and wholly paid for their dwellings, for purchase instalments, etc., ground rent, rates and water charges ...	19 1½	20 5½	25 5½	30 0	21 0½
26-7 (a).	Average Net Weekly Expenditure on rent or purchase of dwelling, ground rent, rates and water charges over all households (including the small number provided with dwellings rent-free) ...	19 0	20 0½	25 9	34 10½	21 1½
30.	Average Net Number of Rooms Occupied ...	5.1	5.6	6.0	7.6	5.5
<i>Average Expenditure per Household on Food</i>						
		s. d.	s. d.	s. d.	s. d.	s. d.
33.	Bread ...	1 7½	1 10	1 11½	2 3½	1 9½
34.	Flour ...	0 6½	0 6½	0 7	0 6½	0 6½
35.	Cakes, buns, pastries, currant bread, etc. ...	1 2½	1 5	1 7½	2 0½	1 4½
53.	Biscuits ...	0 8½	0 10½	1 0½	0 11½	0 10
54.	Proprietary cereals ...	0 3½	0 4	0 5½	0 6½	0 3½
55.	Oatmeal, etc. ...	0 1	0 1½	0 2	0 1½	0 1½
56.	Rice, sago, tapioca, semolina, barley, macaroni, vermicelli ...	0 1½	0 1½	0 1½	0 1½	0 1½
	Total—Bread, Cereals and Related Products ...	4 6	5 2½	5 10½	6 7½	5 0½

TABLE XXII—*Continued*

Key No.		Income of Head of Family				
		Over £250 and up to £350	£350 and up to £500	£500 and up to £700	£700 and over	All
		s. d.	s. d.	s. d.	s. d.	s. d.
64-5.	Beef and veal (joints, cuts, mince) ...	2 3½	2 9½	3 4½	3 7½	2 8½
66-7.	Mutton and lamb (joints, cuts, mince) ...	1 7½	2 0½	2 3½	2 10	1 11½
68.	Pork (joints, cuts, etc.) ...	0 4½	0 5½	0 4½	0 5	0 5
69.	Canned and potted meat ...	0 3	0 4	0 3½	0 4	0 3½
70.	Sausages and meat pies ...	0 6½	0 8½	0 10	1 0½	0 8
71.	Other meat (kidney, liver, fry, heart, head, sweetbreads, tripe, cow- heels, brawn, etc.) ...	0 3½	0 3½	0 4½	0 5½	0 4
72.	Rabbits, poultry, game, etc. ...	0 4	0 5½	0 7	1 2	0 5½
45.	Bacon and ham—cooked and un- cooked (including gammon) ...	1 7	1 9½	2 2	2 3	1 9½
73-4.	Fish—fresh (including shell fish) ...	0 9½	0 11½	1 4½	1 9	0 11½
75.	Fish—dried and cured ...	0 2	0 2½	0 4	0 4½	0 2½
63.	Fish—canned, and paste ...	0 4½	0 4½	0 5	0 4½	0 4½
76.	Fish—fried, and chips ...	0 1½	0 1½	0 0½	0 0½	0 1½
	Total—Meat and Fish ...	8 8½	10 7	12 6½	14 7½	10 3
36.	Milk—fresh, whole (excluding milk obtained away from home) ...	4 1	4 8½	5 5½	6 1½	4 7½
37.	Milk—liquid skimmed (including butter-milk) ...	0 0	0 0½	0 0½	0 0	0 0
38.	Milk—condensed ...	0 0½	0 0½	0 0½	0 1½	0 0½
51.	Dried milk and milk preparations ...	0 2½	0 3	0 2½	0 1½	0 2½
52.	Cream ...	0 2½	0 3	0 4½	0 6½	0 3
39.	Butter ...	2 4½	2 9	3 1½	3 3½	2 8
40.	Margarine ...	0 2½	0 2½	0 3	0 3½	0 2½
41.	Lard (including compound lard) ...	0 2½	0 2½	0 2	0 2½	0 2½
42.	Suet, dripping and other cooking fats ...	0 2	0 2½	0 2½	0 2½	0 2½
43.	Cheese ...	0 6½	0 6½	0 7½	0 8½	0 6½
44.	Eggs ...	1 11½	2 3	2 10½	3 2	2 3
	Total—Dairy Foods, etc. ...	10 0½	11 6	13 4½	14 8½	11 3
46.	Tea ...	1 3½	1 5½	1 6½	1 7½	1 5
59.	Cocoa and cocoa essence ...	0 1½	0 1½	0 1	0 0½	0 1½
60.	Coffee and coffee essence ...	0 1½	0 2½	0 3½	0 5½	0 2½
	Total—Tea, Coffee and Cocoa ...	1 6½	1 9	1 10½	2 1½	1 8½
47.	Sugar ...	0 10½	1 0½	1 2½	1 3½	0 11½
48.	Jam and marmalade, etc. ...	0 5	0 5½	0 6½	0 8½	0 5½
49.	Syrup, treacle, honey ...	0 1½	0 1½	0 2	0 3	0 1½
	Total—Sugar and Preserves ...	1 4½	1 7½	1 11	2 2½	1 7
77.	Potatoes ...	0 9	0 10½	0 11½	1 0½	0 10
78.	Cabbage, broccoli, cauliflower, sprouts, greens, spinach, kale, etc. ...	0 3½	0 4	0 4½	0 7	0 4½
79.	Beans and peas (fresh), etc. ...	0 1½	0 2½	0 2½	0 3½	0 2
80.	Parsley, lettuce, celery, cress, etc. ...	0 1½	0 2½	0 3	0 3½	0 2½
58.	Dried legumes, etc. ...	0 0½	0 0½	0 0½	0 0½	0 0½
81.	Tomatoes ...	0 5	0 6	0 7½	0 7	0 5½
82.	Carrots, swedes, turnips, artichokes, beetroot, radishes, cucumber, mar- rows, etc. ...	0 2½	0 3½	0 3½	0 4½	0 3½
83.	Onions, leeks and shallots ...	0 1½	0 1½	0 1½	0 2	0 1½
62.	Canned and bottled vegetables ...	0 1½	0 2½	0 3	0 3½	0 2½
	Total—Vegetables ...	2 4	2 8½	3 2½	3 9	2 8
84.	Apples ...	0 7½	0 9	0 11½	1 0	0 8½
85.	Oranges ...	0 7	0 8½	0 9½	0 10	0 8
86.	Bananas ...	0 3½	0 4½	0 5	0 6	0 4½
87.	Other fresh fruit, and nuts ...	0 8½	0 10½	1 3½	1 6	0 10½
50.	Dried fruits ...	0 4½	0 5½	0 7½	0 7½	0 5½
61.	Canned and bottled fruits ...	0 4½	0 6	0 8½	0 9½	0 6
	Total—Fruit ...	2 11½	3 7½	4 10	5 2	3 7½

TABLE XXII—Continued

Key No.		Income of Head of Family				
		Over £250 and up to £350	£350 and up to £500	£500 and up to £700	£700 and over	All
		s. d.	s. d.	s. d.	s. d.	s. d.
88.	Sweets, chocolates, ice cream, lemon- ade powder, etc. ... ..	0 8	0 10½	0 11½	1 1	0 9½
89.	Malt and cod liver oil, etc. ... ..	0 2½	0 1½	0 2	0 2½	0 2
57, 90.	Miscellaneous ... ..	0 9½	1 0½	1 3½	1 5½	1 0
	Total—Other Food (excluding meals, etc., away from home) *	1 8	2 0	2 5½	2 9½	1 11½
	Total Expenditure on Food (including meals, etc., away from home) * ... ..	33 2½	39 0½	46 0	52 0½	38 1½
91.	Meals, etc., at { Meals ... ..	0 1	0 2½	0 7½	0 7	0 3
92.	{ Milk ... ..	0 0½	0 1	0 1	0 0½	0 1
93.	School { Other food, etc. ... ..	0 0	0 0½	0 0½	0 0½	0 0½
94.	Other Meals, { Mid-day meal ... ..	1 5	1 10	4 3½	8 6½	2 4
95.	etc., away { Other meals ... ..	0 9	0 10½	1 6½	3 3½	1 0½
96.	from home { Milk ... ..	0 0½	0 0½	0 0	0 0½	0 0½
	Total—Meals, etc., away from home ... ..	2 4½	3 0½	6 7½	12 6½	3 8½
	Total Expenditure on Food (including meals, etc., away from home) * ... ..	35 6½	42 1½	52 7½	64 6½	41 10
<i>Average Expenditure per Household on Clothing</i>						
C.114-5.	Men's clothing and materials ... ..	3 0½	4 2½	5 9½	7 4	4 1½
C.116-7.	Women's clothing and materials ... ..	5 6½	5 9½	7 10½	11 9½	6 4
C.118-9.	Children's clothing and materials ... ..	1 3½	2 4	3 1½	3 1½	2 0½
C.120-1.	Boots and shoes ... ..	1 7½	1 11	2 1½	2 10	1 11½
C.122.	Clothing repairs, cleaning and dyeing ... ..	0 3½	0 4	0 5	0 7½	0 4
C.123.	Repairs to boots and shoes ... ..	0 7½	0 9½	0 10½	0 11½	0 9
	Total Expenditure on Clothing ... ..	12 5	15 4	20 5½	26 7½	15 6½
<i>Average Expenditure per Household on Fuel and Light</i>						
101.	Coal ... ..	4 0½	4 11½	6 3½	6 6½	4 9½
102.	Coke ... ..	0 3½	0 6	1 3	1 11½	0 7½
171-4.	Gas (including meter rent, fittings, etc.) ... ..	1 6½	1 8	1 11½	3 5½	1 8½
175-8.	Electricity (including meter rent, fit- tings, etc.) ... ..	1 10½	2 2½	2 9	3 6	2 2½
103.	Oil ... ..	0 1½	0 1½	0 1	0 0½	0 1½
104.	Other fuel and light (firewood, candles, matches, etc.) ... ..	0 6½	0 7½	0 6½	0 7½	0 6½
	Total Expenditure on Fuel and Light ... ..	8 5½	10 1½	12 10½	16 2	10 1
<i>Average Expenditure per Household on Other Items</i>						
105.	Soap (including soap flakes) ... ..	0 11½	1 0½	1 2½	1 5½	1 0½
106.	Soda, polishes and cleaning materials ... ..	0 5	0 5½	0 7½	0 9½	0 5½
107.	Ironmongery, hollow-ware, cutlery, tools, etc. ... ..	0 5½	0 9	1 2	0 11	0 8½
108.	Household brushes and brooms ... ..	0 5½	0 8½	0 5½	0 3½	0 6½
109.	Pottery and glassware ... ..	0 3½	0 5	0 5½	1 3	0 5
110.	Drapery and haberdashery ... ..	2 5½	3 1½	3 3½	4 9½	2 11½
111.	Furniture ... ..	3 3½	4 2½	6 8½	9 3½	4 4½
112.	Carpets, linoleum, mats, etc. ... ..	1 10	1 5	2 2½	1 5½	1 8½
113.	Other household utensils and equip- ment ... ..	0 7½	1 2½	0 7½	0 10	0 10½
	Total—A. Household ... ..	10 10½	13 3½	16 9	21 0½	13 0½
124.	Tobacco ... ..	0 6	0 8	1 0½	1 0	0 8
125.	Tobacco and cigarettes not distin- guished ... ..	0 5½	0 7½	0 9½	0 10½	0 6½
126.	Cigarettes ... ..	1 10	2 0	2 0½	2 4½	1 11½
	Total—B. Tobacco and Cigarettes ... ..	2 9½	3 3½	3 10½	4 3	3 2½

\* Excluding (also) food for animals, etc., and alcoholic and soft drinks.

TABLE XXII—*Continued*

		Income of Head of Family				
		Over £250 and up to £350	£350 and up to £500	£500 and up to £700	£700 and over	All
Key No.		s. d.	s. d.	s. d.	s. d.	s. d.
127-9.	Travelling to	0 10½	1 7½	2 8½	8 9½	1 9½
130.	and from work	1 3½	1 6½	1 5½	1 3	1 4½
131.	Other	0 8	0 10	1 6½	2 3½	0 11
132.	travelling	1 3	1 6	1 9½	2 1½	1 5½
	{Rail ... ..					
	{Bus, tram, coach, etc.					
	Total—C. Travelling	4 1	5 5½	7 5½	14 5½	5 6½
133.	Newspapers, magazines and other periodicals	1 4½	1 6½	1 9½	2 1	1 6½
134.	Books, stationery, pens, pencils, etc.	0 8½	0 11½	1 9½	2 10½	1 0½
135.	Postages	0 9½	0 11½	1 1½	1 7½	0 11½
136.	Telephones and telegrams	0 5½	1 2½	2 8	5 11½	1 4
	Total—D. Newspapers, Books, Stationery, Postages, etc.	3 3½	4 8½	7 4	12 6½	4 10
137.	Cinemas	1 0	1 2½	1 5	1 7½	1 2
138.	Theatres, music-halls, concerts, dances, etc. (not sports and games)	0 8	0 10½	1 10½	2 11½	1 0½
139.	Admission charges to watch sports, games, etc.	0 4	0 6	0 9	0 6½	0 5½
	Total—E. Entertainments	2 0	2 7	4 0½	5 2½	2 8
180.	Education	0 10½	3 5½	7 11½	14 5½	3 5½
	Total—F. Education	0 10½	3 5½	7 11½	14 5½	3 5½
140.	Hairdressing, etc.	0 11½	1 0	1 3½	1 11½	1 1
145.	Chemists' sundries	0 6	0 7½	0 9½	0 11½	0 7½
151.	Laundry	1 0½	1 3½	1 10½	3 0½	1 4½
	Total—G. Hairdressing, etc., Chemists' Sundries, Laundry	2 6	2 10½	3 11½	5 11½	3 0½
143.	Doctor, dentist, nurse, midwife, op- tician, etc.	3 3	5 6½	6 4½	9 9½	4 10½
144.	Medicines, drugs, medical and sur- gical appliances, etc.	1 1	1 3	1 5½	2 0½	1 3
146.	Payments to hospital funds, hospital fees, etc.	0 7½	0 7	1 0	0 7	0 7½
	Total—H. Doctors' fees, etc., Medicines, Hospital Payments, etc.	4 11½	7 4½	8 10	12 5½	6 9
148.	National Health, Pensions and Un- employment Insurance	0 10½	0 9½	0 9½	0 4½	0 9½
149.	Payments to Pension Funds, Insur- ance Premiums, etc.	7 10	13 1½	13 11½	12 8½	10 10½
147.	Trade Union, etc., subscriptions	1 8½	1 11½	0 11	0 8½	1 7½
	Total—I. Insurance, Pensions, Trade Union, etc., subscriptions	10 5	15 10½	15 7½	13 10	13 4
150.	Licences (dog, radio, motor-car, etc.)	1 2½	1 6½	2 5½	1 2½	1 6½
152.	Wages paid for domestic help	1 10	3 1½	6 5½	14 9½	3 7½
153.	Holiday expenditure	0 6½	0 6½	0 10½	0 7½	0 7
	Total—J. Domestic Help, Licences, Holiday expenditure	3 7½	5 2½	9 9½	16 7½	5 8½
154.	Food for animals, poultry, birds, etc.	0 3	0 3½	0 3½	0 7½	0 3½
155.	Drink (alcoholic)	1 0½	1 7½	1 11½	4 9½	1 6½
156.	Drink (soft drinks)	0 2½	0 3	0 3½	0 7½	0 3½
	Total—K. Drinks, and Food for Animals, etc.	1 6	2 1½	2 6½	6 0½	2 1½

TABLE XXII—Continued

Key No.		Income of Head of Family				
		Over £250 and up to £350	£350 and up to £500	£500 and up to £700	£700 and over	All
		s. d.	s. d.	s. d.	s. d.	s. d.
157.	Sports, games and other forms of exercise ... ..	0 6½	0 10½	1 10½	4 5½	1 0½
158.	Motor-cars, motor-cycles and pedal-cycles, including vehicle, petrol, oil, etc. (not licences or insurance premiums) ... ..	3 4	4 8½	10 5½	23 8½	5 10
159.	Gardening—rent, seeds, plants, etc. ... ..	0 7½	1 2½	1 3½	0 11½	0 11½
160.	Radio (not licences) ... ..	1 1½	1 6½	0 10½	1 5½	1 3
161.	Allowances ... ..	0 5	0 8½	0 10½	3 9½	0 9½
162.	Religion and charity ... ..	0 10	1 6	2 1½	5 6½	1 6
163.	Gifts, toys, children's pocket money ... ..	0 7½	1 1½	2 1½	3 6½	1 2½
164.	Legal, etc., and bank charges ... ..	0 1½	0 5½	0 2	0 1½	0 3
165.	Decoration of house ... ..	3 0	3 10½	3 5½	1 6½	3 3½
166.	Window cleaning ... ..	0 3½	0 4½	0 5½	0 5½	0 4½
167.	Watches, clocks, and jewellery, and repairs ... ..	0 3½	0 4½	0 5½	1 2½	0 4½
168.	Suitcases, attaché cases, handbags, umbrellas, walking-sticks ... ..	0 2	0 3½	0 4	0 8½	0 3½
169 70.	Miscellaneous ... ..	2 3½	2 7½	3 7½	5 1½	2 9
	Total: L. Other ... ..	13 8½	19 8½	27 10½	52 7½	19 10½
	Total Expenditure on Other Items ... ..	60 6½	85 9½	116 1½	179 6½	83 7
<i>Summary of Average Expenditure per Household</i>						
	Food ... ..	35 6½	42 1½	52 7½	64 6½	41 10
	Housing ... ..	19 0	20 0½	25 9	34 10½	21 1½
	Clothing ... ..	12 5	15 4	20 5½	26 7½	15 6½
	Fuel and Light ... ..	8 5½	19 1½	12 10½	16 2	10 1
	Other Items ... ..	60 6½	85 9½	116 1½	179 6½	83 7
	Total ... ..	135 11½	173 4½	227 9½	321 8½	172 1½

## DISCUSSION ON MR. MASSEY'S PAPER

DR. BRADFORD HILL opened the proceedings by reading the following contribution from PROFESSOR A. L. BOWLEY :—

I regret that it was impracticable for me to be present at the reading of Mr. Massey's paper, for I should have wished to have expressed personally my sense of the great importance of the investigation the results of which he has summarized, and gratitude for the time and effort which he and his coadjutors had devoted to it. It forms a very valuable supplement to the Cost-of-Living Enquiry conducted by the Ministry of Labour in 1937-8, especially as it was arranged so as to be strictly comparable. It is to be hoped that the budgets will be preserved so as to be available for further analysis on specific questions—analysis which will become more expedient if the Ministry of Labour is able to publish further details.

No doubt many statisticians will, when they can find time, compare the results of the working-class and middle-class budgets. I have made some tentative tabulations, which show that there is a rich field for exploration. For example, using conventional "man-values," I find that the weekly expenditure per "man" on food was 10s. 8d. in the working-class budgets, and successively 14s. 3d., 14s. 6d., 17s., and 18s. 10d. in the four ascending middle-class groups. Excluding meals out, the figures are 10s. 4d., 13s. 3d., 13s. 5d., 14s. 11d., 15s. 2d. The principal increases are on dairy produce and fruit, on which together expenditures per "man" were 3s. 7d., 5s. 3d., 5s. 8d., 5s. 8d., and on meat, etc., 3s., 3s. 6d., 4s., 4s. 3d. There is generally a change in the pattern of expenditure



as one goes up the scale of incomes, and there is, I think, a suggestion that the Engel line is not linear.

There is, I think, a serious qualification to be made as regards the statistics of housing expenditure because of the increasing number who owned their houses as income increased, while in the highest group the number still paying for the purchase diminished. In the working-class budgets, where the number owning or buying was small, it is not unreasonable to balance the excess of purchase payments over rent of some against the zero rent of those who had completed the payment; actuarially the difference should be small. But in the middle-class budgets the percentages of buyers and of owners is considerable. For the buyer, the payments are partly rent, partly investment; for the owner, the value is the result of saving, and the assessed annual value is counted as income for income-tax purposes. If we add the assessed value of owned houses and allow for the element of savings in purchase payments, as indicated in the footnote,\* we can proceed as follows, taking hypothetical values for excess of purchase payment over rent, and for rates.

				Salary Range				
				£250-	£350-	£500- shillings	£700-	All
Cash housing expenditure	...	...	...	19.0	20.0	25.7	34.9	21.1
Less savings	...	...	...	1.1	1.2	1.6	1.3	1.2
Plus interest on investment	...	...	...	2.2	2.7	3.9	6.8	2.7
True rental expense				20.0	21.5	28.0	40.4	22.6

This method carried out systematically would, I think, put the relation of housing to other expense in a truer perspective than that of the cash basis.

I suggest that it would be more accurate if the word *income* was replaced by *salary* in every tabular heading where it occurs. There are no statistics of total income in this paper, nor were there in the corresponding working-class budgets.

DR. HILL then proposed a cordial vote of thanks to the author. Referring to the sampling problems involved in the study, he said that much trouble had clearly been taken to obtain a representative sample of the population concerned, but how far that effort had been successful was hardly discussed; yet the budgets came from only 40 per cent. of those who undertook to participate, or from rather less than a quarter of the estimated maximum sample that should have been available. Reliance on voluntary participation was inevitable in these enquiries, but must always lead to some departure from a representative sample. For instance, the budgets sent in by those who had helped for less than the full four weeks were much less reliable than those which related to all four weeks. But the latter may have come from the more methodical and careful section of the population, amenable to filling in forms, and possibly with a pattern of expenditure quite different from the average. It might have been possible, using some items of expenditure reported with good reliability, to see whether the average expenditure of the "non-fours" did in fact differ appreciably from that of the "all-fours." If it did not, one could feel somewhat happier about the "all-fours" as a fair sample.

\* The working is as follows:—write  $r_1$  for rent of houses rented,  $r_2$  for rental value of houses owned or being purchased, rates included in all cases. Write  $r_2(1 + f)$  for annual purchase payments and  $gr_2$  for rates.  $x, y, z$  are the relative numbers of houses in each class. Then housing expenditure as given in the paper may be written:

$$r_1x + r_2(1 + f) \pm r_2gz = (x + y + z)\bar{r}, \text{ say.}$$

Here  $x, y, z, r_1$  and  $\bar{r}$  are given in the text.

True rent (including rates) is  $xr_1 + (y + z)r_2$ .

Hence  $r_2fy$  is saving and  $(1 - g)r_2z$  is interest on investment.

As a working hypothesis  $f$  is taken as  $1/9$  and  $g$  as  $3/8$ . The actual values could presumably be approximately ascertained. Then  $r_2$  is determined.

Other checks on the "all-fours" might, perhaps, have been obtained: *e.g.*, Table V showed the numbers of civil servants in the sample earning different incomes. Was this distribution an accurate representation of the sum of civil service incomes or, if not, to what extent were the different classes wrongly weighted in reaching the total figures? In size of family, too, it might have proved possible to find a check.

Turning to the expenditure on clothing, a noticeable point was the very much higher annual expenditure given by the weekly budgets when compared with the returns for the whole year made by a smaller sample. Mr. Massey believed the explanation to be that the former included expenditure not actually incurred in the weeks for which the budgets were required. On the other hand, the returns compiled for the whole year also showed a relatively high expenditure on clothes in those particular four weeks, and Dr. Bradford Hill suggested that the explanation might rather be that a sample of four weeks, even spread over the year, would not necessarily be representative of the annual expenditure. Mr. Massey had pointed out that the four-weeks' data could not give a reliable figure for the annual average expenditures on such items as income-tax, education, gas and electricity. The same might apply to clothing in a population of this type, expenditure being partly governed by such features as the dates of school terms or even the date of Easter and its reputed association with new bonnets. There were two possible ways of getting over this difficulty. Mr. Massey had adopted that of getting returns for a whole year from a smaller sample; this led to the selection of those who were prepared to fill in forms for so long a period, most probably a still more unrepresentative sample. An alternative method had been adopted by Dr. Bradford Hill in an enquiry into the average number of services given by doctors to their insured patients. In such an enquiry it was essential to cover the whole year because of the seasonal and epidemic swings in sickness, but doctors who would keep records for a whole year might well be exceptional. The method adopted therefore was to take a large random sample of all the doctors, divide this, again at random, into twelve equal sub-groups, and ask the members in each to keep records for a defined month. Each group was, thereby, required to do a relatively small task, each was a random sample of the total, and the experiences of the whole year were covered. The link-up from one sample to the next and the general characteristics of each group provided some tests of the adequacy of the method.

Applied to the present enquiry, instead of having 1,360 persons keeping a record in each of four different weeks at quarterly intervals, one could have had some 100-125 keeping a record throughout each month of the year. It was a method, in his opinion, with which it would be of value to experiment in budgetary enquiries.

MR. CAMPION, in seconding the vote of thanks, said:—

I like Mr. Massey's paper for two reasons. First it fills an important gap in our information about how people lived before the war. It is almost certain that 1938 will become the accepted pre-war base year for calculating changes in incomes, prices and wages after this war. It is therefore necessary to have as much information as possible about economic and social conditions in that year, and we have gone very far in this direction. For 1938 we have the results of the earnings census of the Ministry of Labour. We know something of the personal distribution of incomes and the personal distribution of capital in that year. We know something of the distribution of salaries paid and also of the distribution of the higher incomes. We also know the breakdown of the national income and expenditure in 1938. We have got the results of the Ministry of Labour family-budget enquiry, and today we have been given the results of Mr. Massey's enquiry about middle-class households. In 1938, therefore, we have a very satisfactory base year indeed for calculating changes in prices, wages and incomes after the war.

The second reason why I like Mr. Massey's paper is because it is a most valuable supplement to the Ministry of Labour family-budget enquiry in 1937—

38. We know now for the first time a very great deal of how people at different ranges of incomes spend their money, and we are therefore able to form some idea not only of total aggregate personal expenditure, but also of how this expenditure varies according to different income or expenditure groups. In view of the importance of his enquiry, therefore, I should like to raise a number of points of interpretation of Mr. Massey's paper.

(1) Although, as I have stated, it is most valuable to have the information on this enquiry prepared in such a way as to be comparable to the Ministry of Labour enquiry, the character of middle-class expenditure is different from that of industrial households, and does not lend itself so easily to the same kind of analysis. This difference comes out in the question of rents, where such a large proportion of the households are not paying rent, but are acquiring their own houses. In his final table showing the analysis of expenditure by classes he has included the payment made by people buying their own houses.

(2) I am very sorry that Mr. Massey was not able to get satisfactory answers as regards the quantity of food bought. One of the questions for which no answer has yet been satisfactorily given is whether the rise in expenditure on different items of food according to various income or expenditure groups is due to (a) a larger quantity of food being bought, (b) a higher quality of food being bought at different income levels or (c) merely higher prices being paid for the same commodity. I hope that even the incomplete information which Mr. Massey has may enable him at some time to throw some light on this difficult question.

(3) I should like to ask Mr. Massey more about how far he thinks his figures of expenditure on meals away from home can be really trusted. People do not usually keep a regular account of any expenditure they make away from home in the way of meals. Further, since there is more than one earner in a large number of the households, is it certain that he has been able to include in the family expenditure the expenditure of all these people, particularly on meals they take away from home?

(4) Mr. Massey has followed the procedure of the Ministry of Labour in asking for details of clothing expenditure over the year, as distinct from the four weeks of the enquiry, and as he shows in Tables XV and XVI, there is a difference between 15s. 6½d. on the average for the year and 22s. 10d. for the four weeks. I should be glad to know if he has any further explanations of the difference between these two figures. I am not quite satisfied that he is right in disregarding completely the expenditure in the four-weekly periods and using only the lower figure as shown by the annual average. Is it not possible that the higher expenditure in particular weeks on clothing will have reduced the expenditure on other items during those weeks, especially with a class of people whose incomes are fairly stable, and do not fluctuate a great deal over the year?

One last point I would like to make relates to the class of people to which Mr. Massey's figures apply. They refer to civil servants, teachers and local authority officials, all of whom have regular incomes and do not suffer much unemployment. The majority of civil servants live and work in London. Their expenditure habits, therefore, may be expected to be more constant and also more stable over a longer period than other middle-class families.

MR. R. F. GEORGE said that this was one of the most important budget collections the Society had had placed before it. This type of enquiry had been concentrated on poor sections of the community, and extremely little was known of the middle-class expenditure. The Society was indebted for this extension to their knowledge. The indebtedness was threefold: first of all to the Civil Service Statistical and Research Bureau, secondly to Mr. Massey for bringing forward the results, and thirdly to the noble army of 1,360 martyrs who provided the original details of the enquiry.

He thought Mr. Massey was fortunate in securing a response of 22½ per cent. of the practical maximum. It was unfortunate that the material was classified

almost entirely on the income of the head of the family alone. The strength of Mr. Massey's arguments for dealing with it in that way was fully appreciated, but it was a pity that an endeavour was not made to collect information about family income as opposed to the income of the head of the family. It appeared that there were five salary-earners to every four households, and that should throw a number of families into a higher group. Apparently no information was secured regarding supplementary forms of income. It was not unlikely that there was a proportion of elderly people in receipt of an old age pension or other form of income living with a married son or daughter.

There was a particular interest in the tables of food expenditure, particularly Tables IX and X. Immediately above Table X Mr. Massey expressed the doubt whether that table gave a better index of the position of the nutritional standard than Table IX, but since both of these tables were in terms of money spent and not of food consumed, Mr. George suggested that neither gave evidence of the nutritional content of the diets.

Mr. Massey also pointed out that the information available on the quantities of food purchased was much less reliable than on the expenditure. That could be readily understood, but there must be a good deal of excellent material relating to quantities purchased from which some index of the nutritional standard of these households could be calculated. They might be consuming vastly more than the amounts laid down by authorities, but, on the other hand, they might be mis-spending their incomes and consuming an unbalanced diet. It was also unfortunate that food expenditure had been expressed per head. Professor Bowley had referred to this point, and had calculated what the average would be on the adult equivalent basis. Mr. George had independently made similar calculations with the same conclusion, that the averages worked out considerably higher than on the per head basis as given in the paper. The over-all average looked as if it should be about 2s. per week more than the figures shown in the paper.

Mr. Massey's work had emphasized how much more knowledge was needed and Mr. George would like to see, perhaps in less violent times than the present, a greater degree of official participation in these researches, particularly in the way of financial assistance. These enquiries were costly and yielded results of first-class national importance.

SIR JOHN ORR said that the figures given for expenditure on food were in close agreement with a dietary survey of 1,500 families done from the Rowett Institute in 1937-39. At that time a diet fully adequate for health, on a free-choice basis, cost from 7s. 6d. to 10s. per head, according to the season and district. 11s. 2d., the expenditure in the £250-350 group, was, therefore, ample for the purchase of an adequate diet, provided the money was wisely expended.

The percentage of the total family income spent on food rose from 20 per cent. in the families with over £700 per annum to 26 per cent. in the £250-350 group. Other enquiries covering the poorest classes showed that the rise was much steeper with fall in income below the £250-per-annum level. In working-class families it was between 40 and 50 per cent., and amongst the poorest families it rose to between 60 and 70. This difference in the percentage of the total family income spent on food was of both social and economic importance. Any direct or indirect tax on food was levied on over 50 per cent. of the income of the very poor, but on only 20 per cent. or less of the income of the well-to-do. On the other hand, any subsidy on food in the interests of the consumer gave the biggest benefit to the people who needed it most.

The results of enquiries of this nature gave a factual basis for the consideration of post-war social measures. The results of the present enquiry were of special importance because, after the war, families with fixed incomes of between £250 and £500 per annum might become the new poor, which was the case on the Continent after the last war.

MR. BASHAM suggested it was a mistake to include one-person households both in the present and in the Ministry of Labour enquiry. No one could

seriously think that a young bachelor or young spinster was a family, they were in process of becoming either the titular head or the real head of a household. He did not know what proportion one-person households formed in the Ministry of Labour enquiry; in the present enquiry they formed about 4 per cent., but they affected every table: the number of children in the family, the number of rooms; they would affect rather considerably those taking meals away from home, and he could not see what explanation was offered for including them, unless it was something taken over from the old census classification of one-person tenements.

MR. O'BRIEN said that in a small enquiry a few years ago with a group of teachers he came up against the same difficulty of the households which were buying their houses, but in that case his hopes that the average expenditure under such conditions would reflect the increased cost of buying as compared with renting a house did turn out to be fulfilled, since he found in every income group that the expenditure under such conditions was greater than when the house was rented, so that, for some reason which was not determined, Mr. Massey's people were at a much later stage of purchase.

A second point was on the expenditure on food, and it might be of consequence. There had been a number of middle-class enquiries recently, almost all on rather small samples as compared with the present, but these enquiries all corroborated one another on quite different levels to those of Mr. Massey. Of the ones to which he referred, at least one, in Eire, affected the pay of civil servants and the percentage spent on food was 34.5 per cent. In another in Eire, done for the purposes of propaganda by the Civil Service Federation, the expenditure was given as 35.5 per cent. on an average income of £287. In an enquiry by Professor Caradog Jones in 1926 he gave an average of 32 per cent. on an income of £434, and the one which the speaker did himself gave an average of 32.2 per cent. on an average income of £355. These were all sufficiently consistent, but he thought it was desirable to discover just why there was this difference of 8 or 9 per cent. between these results and those which Mr. Massey obtained practically throughout his groups.

MR. KENDALL said that he agreed with Dr. Hill on the question of sampling, and would go somewhat further. At the beginning of the paper Mr. Massey had said that the information obtained must be representative not only of the membership of the organizations covered by the enquiry, but also of the middle-class salary-earners as a whole. As Dr. Hill had pointed out, any self-selected sample might give a slight bias even for the categories covered. Mr. Kendall thought there was a further possibility of error if the sample was regarded as representative of members of other middle-class occupations, such as doctors, lawyers, farmers, and the employees of ordinary commercial businesses.

It might be possible to do a test on the point. If Mr. Massey were to separate the three categories which he had—civil servants, teachers and local government officials—and take a homogeneity test on their expenditure; and if that test revealed any significant differences, as he suspected it might, then the grounds for suspecting differences between the three classes (which had at least in common the fact that they were employed by a government agency) and the other classes which he had mentioned would be strengthened. Mr. Kendall thought that Mr. Massey was going beyond his data in claiming that his figures must be generally representative of middle-class budgets. He might be right, but the speaker thought in any event the case at present was non-proven.

Mr. Kendall's second point concerned the tabulation of the data by households instead of by individuals. In one or two cases figures by individuals were given, but in doing so Mr. Massey had given equal weight to every human being in the household, irrespective of age or condition. Obviously that could not be correct for education, and one would suspect that it would be doubtful for food or clothing. He would like to have seen some reduction of the data to a comparable basis by giving different weights to different sexes, ages and so forth.

The third point concerned the difference between London and provincial rates of pay. Although Mr. Massey did not refer to the point, he thought that probably a great many of these budgets were completed by civil servants resident in London. One would suspect that there were different patterns of expenditure between London and provincial residents—the London resident, for example, spent more on travelling. The fact that it cost more to live in different parts of the country was recognized in the Civil Service by a London and provincial rate of pay.

Finally, one would like to see not only the averages of the various groups, but some sort of dispersion. It was not at all clear from the data how reliable these averages were and how far there were variations of expenditure on different items, even within the sub-groups. He did not suggest that Mr. Massey should try to work out variances for all the items, but it might be as well to look at the more important ones to see how far there was variation even within the homogeneous groups.

He hoped nothing he had said seemed at all critical, because this was an extremely valuable piece of work, and he fully associated himself with what had been said on that point.

THE CHAIRMAN thought it had been recognized by all speakers how significant and useful was the work which Mr. Massey had done in beginning to fill what had hitherto been a great gap in the knowledge of society as it existed before the war. Knowledge in the past of household expenditures had been limited to people who were not civil servants and to people who had incomes generally below £250. They were told by some that after this war we should all be civil servants; they were told by others they would all be much richer, so that what Mr. Massey had done in filling a gap might be the standard from which the whole population would judge its relative happiness after the war. He said that for the further encouragement of Mr. Massey in continuing the kind of work which he had begun, and he might take that same encouragement from everything which had been said about his paper suggesting further testing of his results, as that further emphasized their value.

The fact that so many people wanted to test his results in various ways was an indication of the importance attached to the work which had been done.

The vote of thanks was now put to the meeting and carried unanimously.

The following contribution was received from MR. D. CARADOG JONES, who was prevented from attending the meeting:—

Mr. Massey has been fortunate to have at his disposal for analysis so large and representative a sample of budgets drawn from a reasonably well-defined middle class of households, a class to which too little attention has been paid by statisticians in the past. The period to which his sample relates, coinciding nearly as it does with that of the highly successful official collection of working-class budgets, was equally fortunate. To such good use has the author put his material, so far as he has gone into print with it, there is cause for regret that he has gone no further. The value of a statistical investigation is sometimes much increased when comparison is possible with results reached by other investigators in parallel fields. Since the design of Mr. Massey's enquiry was closely modelled on that carried out under the direction of the Ministry of Labour, he might well have compared the results of the two in detail. Was this omission due to a stringent rationing of the space allotted to writers by the Editors of the *Journal* under war-time conditions? If so, I may be excused for using most of the space allowed to me for discussion for drawing attention to one or two comparisons of possible interest, instead of criticizing points of detail in the paper which would not carry us much further.

In a review contributed to *Nature* (Vol. 147, No. 3726) on "Working-Class Earnings and Expenditure" it was pointed out that in the relative amounts spent on different kinds of food a trend could be traced in working-class expenditure towards middle-class habit or taste, in so far as the latter could be judged by a

small sample of middle-class budgets then available to the writer. The table supporting this view, adapted and with a new column now added, is here reproduced.

*Proportional Distribution of Expenditure on Food*

Expenditure on	Working-class budgets		Middle-class budgets	
	1914	1937-38	1926	1938-39
	per cent.	per cent.	per cent.	per cent.
Meat and fish ... ..	32.0	31.2	37.5	28.4
Bread, cereals, etc. ... ..	21.8	16.7	13.7	14.0
Dairy foods, etc. ... ..	22.3	27.9	25.9	31.1
Vegetables and fruit ... ..	9.7	13.3	13.2	17.4
Sugar and preserves ... ..	7.5	5.1	5.1	4.4
Tea, coffee and cocoa ... ..	6.6	5.8	4.6	4.7

The last column is derived from the corresponding column in Table XIII of Mr. Massey's paper; the earlier collection of middle-class budgets was that discussed in a paper read before the Society fourteen years ago (*J.R.S.S.*, Vol. XCI, Pt. IV). These figures suggest further that, out of the total sum spent on food in both the working class and the middle class, there has been a considerable increase in the proportion spent on dairy products and on vegetables and fruit and a slight decline in the proportion spent on sugar and preserves. The middle class spend proportionally less than in the past on meat and fish, whereas the proportion they spend on bread, cereals, etc., has scarcely altered; just the opposite is true of the working class: they spend proportionately less on bread, cereals, etc., while the proportion spent by them on meat and fish has changed but little.

Another comparison can be added to that made in a footnote by Mr. Massey at the end of his paper, where the amount spent upon food as a whole is related to that spent in other ways.

*Proportional Distribution of Total Middle-Class Expenditure.*

Expenditure on	1926	1938-39
	per cent.	per cent.
Food ... ..	32	24.3
Housing ... ..	14.5	12.3
Clothing ... ..	11	9.0
Fuel and Light ... ..	4.5	5.9
Other items ... ..	38	48.5

Again, on the assumption that we may take these samples as broadly representative of middle-class experience generally, it can be inferred that the proportion of expenditure allotted to food relative to other things has declined substantially during the last twelve years; on the other hand, the rise in the proportion spent on "other items" has been even more striking. The gain under this head, seeing that it includes an appreciable amount of expenditure that is not absolutely essential, is an index of the rise in the average standard of living in the middle class. In the remaining three groups the change is less marked: there has been an increase in the proportion of the total expenditure allotted to fuel and light, and a decrease in the proportion allotted to rent and rates and to clothing.

We may also examine the change in the relative amount spent under different headings which go to make up "other items" in Mr. Massey's Table XIX. Using the detailed list given at the end of his paper I have allocated the various

items so far as possible under the headings which were used in the analysis of the 1926 middle-class budgets (see *J.R.S.S.*, Vol. XCI, Pt. IV, p. 483). The following table gives the result of this comparison.

*Proportional Distribution of Middle-Class Expenditure on Certain "Other Items"*

Key numbers of corresponding items in Table XXII	Expenditure on	Per cent. of total spent on all "other items" here included	
		1926	1938-39
105-13, 145, 151, 152, 154, 156, 165, 166	Housekeeping and service, including laundry and renewals	36·4	31·1
131, 132, 137-9, 150, 153, 157-60	Recreation and holidays	25·1	22·1
147-9	Insurance	15·0	18·2
143, 144, 146	Doctor, dentist, chemist	6·1	9·2
133-6	Papers and stamps	2·6	6·6
124-6, 155	Tobacco and alcohol	6·9	6·5
127-30	Travelling to and from work	4·5	4·3
162	Subscriptions and Charity	3·4	2·0

The items included in this list cover 73s. 5½d. out of the total expenditure of 83s. 7d. in Mr. Massey's "other items." The only ones omitted are those which do not appear to fit appropriately into any of the classifications in the above table. The resemblance between the two columns of figures is as close as we could reasonably expect. The 22·1 per cent. for recreation and holidays in 1938-39 would certainly have been higher if account had been taken of abnormal expenditure incurred during annual holidays as in 1926. The marked rise in expenditure on papers and stamps is in part due to a more general use of the telephone and increased cost of postage.

The merits of the method followed by the author in making his investigation are clear. In particular, a detailed return of expenditure during four separate weeks in the year should at first sight secure a high degree of precision. But precision does not imply accuracy if there is a well-meant but mistaken tendency on the part of budget-keepers to interpret the term "week" elastically. The explanation given for the large differences revealed between the results of the four and the fifty-two weeks' clothing enquiry (Tables XV and XVI) brings that painful fact out clearly. Exactly the same tendency was discovered in the analysis of the Ministry of Labour working-class budgets, and it leads one to question whether it may not also have affected the records of expenditure on several other commodities that are bought infrequently. In short, in dealing with people who normally think in terms of monthly or quarterly accounts, may not the advantage of taking the year instead of the week as the unit period of enquiry very well outweigh the disadvantages?

The source of error just noted prompts the suggestion that it would have been helpful if a full copy of the documents used in the enquiry had been included in the paper. A critical examination of these, with the accompanying explanatory notes, would make it easier to judge whether any instruction was liable to misinterpretation, and so to assess the real value of the raw material.

I should like to congratulate the author on a very concise, clear, and interesting paper, and perhaps the comparisons I have ventured to draw will entice him to pursue his analyses further, seeking especially any contrasts that may be discovered between working-class and middle-class expenditure by reference to the valuable material in the possession of the Ministry of Labour. He himself has suggested other lines of enquiry which I feel sure should prove profitable:



e.g., the analysis of expenditure on food in terms of equivalent man-value, but again, I hope, relating his results to those of other enquiries. I will conclude with one small query which he may be able to answer immediately. Do families who get gas and electricity by use of a slot meter spend more per week on the average than other comparable families? If so, do they use more or pay at a higher rate?

MR. MASSEY, in reply: Several speakers have asked why a number of additional points were not included; the answer is that the normal limit for papers is 25 pages of the *Journal*, and this one runs to 27 as it is.

Professor Bowley expressed the hope that the budgets would be preserved for further analysis; they are in a safe place.

Regarding housing expenditure, it seemed best simply to present the figures of actual expenditure as yielded by the enquiry. An analysis on the lines suggested by Professor Bowley would obviously be of value, but I feel it would not have been appropriate in this paper.

Professor Bowley suggested that it would be more accurate to use the word *salary* instead of *income*, because there are no statistics of total income in the paper. The figure which participants were asked to state was that of *income of head of family* (see under heading "The Income and Household Groups") and that is the phrase which is used throughout the tables.

Dr. Bradford Hill raised the question of how far those who returned eligible and effective budgets for all four weeks formed a representative sample. For an enquiry of this type, the percentages of 40 and 23 are surely very high; a number of past investigations have produced a response of only 5 or 10 per cent., and this when the information required has been less detailed than in the enquiry under discussion. I note that Mr. Caradog Jones regards the sample as a large and representative one. The fact that it is the steady-going sort of person, in general, who is willing to fill in such questionnaires is, of course, an invariable handicap in any investigation, but the response to this enquiry was very good—it was not just a small minority of highly methodical people.

As regards possible independent checks on the "all-fours," there do not exist any records sufficiently accurate for the purpose.

I think there can be no doubt that my interpretation of the discrepancy between the expenditures on clothing resulting from the main enquiry and the special clothing enquiry is the correct one. The same thing happened in the Ministry of Labour enquiry and the same conclusion was drawn. The first week of the middle-class enquiry was that starting a week after Easter Sunday.

I am very doubtful whether the method adopted by Dr. Hill for an enquiry into the number of services rendered by doctors would be suitable for a budgetary enquiry.

Mr. Campion, and also Mr. R. F. George, raised the question of the extent to which the figures of quantities of food purchased would provide useful material. Even the incomplete information would, I think, be of some use on the question of nutritional standards, and also for throwing light on the specific point raised by Mr. Campion. It would involve, however, complete re-examination of the budgets, which is out of the question at the present time. Mr. Campion did not mention service (including credit), which would be a big factor in price differences for the same quality goods. In general, it would only be possible to separate Mr. Campion's "*a*" (larger quantities) from  $b + c + d$ , "*d*" representing service.

Mr. Campion said that people do not usually keep a regular account of any expenditure they make away from home in the way of meals. Most people do not keep accounts of cash expenditures at all, but it was necessary for those who took part in the enquiry to do so, and this was emphasized at each stage. As regards personal expenditures in general, there is in the paper (under heading "The Three Forms of Enquiry") a description of the preliminary instructions given, and of the method of the "personal expenditure form."

The figures for a whole year's clothing expenditure must surely be about right. Mr. Campion asked whether the higher expenditure on clothing in the

weeks of enquiry might have reduced expenditure on other things. Since I don't think they *really* spent more in the four weeks, this does not arise.

I am very glad to have Mr. George's appreciative comments, and also those of the Chairman, of Mr. Campion, and of others who have taken part in the discussion. I should like to add to Mr. George's statement of the Society's threefold indebtedness its indebtedness to the organizations which financed the enquiry, and also to associate myself with his plea for a greater degree of official participation in such investigations.

Mr. George said it was a pity that an endeavour was not made to obtain family incomes. I have reason to believe, from previous experience, that family income would not have been given correctly in some cases, and that the insertion of such a question would have deterred some people (chiefly, of course, people with more than one source of income) from taking part, and would thereby have caused bias.

Mr. George has read more into my reference to the nutritional standpoint than I intended. What I meant was that probably Table IX gave a better indication of whether enough money was being spent to obtain a fully adequate diet, assuming wise expenditure. Sir John Orr pointed out later in the discussion that the figures in Table IX did, in fact, show that the food expenditure in the £250-350 group was ample, on that assumption.

Mr. George considers it unfortunate that food expenditure was expressed per head, but the necessary facts for expressing it by man-value are given in the paper. Naturally these averages come out higher.

Mr. Basham is against the inclusion of one-person households. I can only say that I would be against their exclusion from such an enquiry, and the onus is surely on Mr. Basham. Lodgers, etc., were excluded, of course.

Mr. O'Brien mentioned other enquiries which had shown a higher proportion of expenditure devoted to food. I can think of several possible explanations. Drinks and food for animals were not counted as food in the enquiry under discussion; their inclusion would raise the percentages on food by rather over 1 per cent. (in the top income group nearly 2 per cent.). There is a long-term trend downwards in the proportion spent on food, in part the result of smaller families, which may be a third factor, and in part the result of food having become relatively cheaper, which may be a fourth. [From 1926 to 1938 retail food prices, according to the official index, declined by 14 per cent., fuel and light by 12 per cent., clothing by 5 per cent., and the other items in the index, apart from rent, by 3 per cent. (The figure for working-class rents increased by 7 per cent., but this is irrelevant in the present connection.)] Two, at least, of the enquiries which Mr. O'Brien mentioned were among households with lower average incomes than those in the enquiry under discussion (and these latter, it must be borne in mind, are incomes of heads of families only). To determine which of these factors apply would involve studying not only the reports, but also the preliminary instructions respecting scope, eligibility, etc., of all the investigations concerned. In present circumstances, this would involve too great a task.

Regarding Mr. Kendall's first point, what I suggested at the beginning of the paper was that the information obtained must be broadly representative, not only of the membership of the participating organizations, but also of the middle-class, and in particular of salary-earners, as a whole. "Broadly" and "as a whole" are qualifying phrases which Mr. Kendall has rather overlooked.

There is much less "London bias" than Mr. Kendall seems to think. The civil servants' budgets formed only one-third of the whole, and by no means all civil servants live and work in London. Teachers and local government officers are spread over the country in very similar proportion to the population as a whole. Altogether, about five-sixths of the participants would be divided proportionately between London and the provinces, and about one-sixth would be mainly Londoners.

I am sorry that I cannot answer Mr. Caradog Jones's question about slot-

meter and other consumers. A special analysis of the budgets would be necessary.

It does not seem likely that any serious errors will have occurred through elastic interpretation of the term "week." Despite the discrepancy in regard to clothing expenditure this was my own view before I saw Mr. Caradog Jones's comments, and it is somewhat reinforced by the close correspondence between the figures in the last two columns of his third table.

Mr. Caradog Jones suggests that I might have compared in this paper the results of the enquiry with those of the official working-class enquiry. My object here was to set out the middle-class expenditures in as much detail as possible in the amount of space available. (A full copy of the documents used would occupy many pages of the *Journal*.) The comparisons deserve a separate study, and it is my intention to pursue the analyses of the results of the enquiry further, in particular by comparing them with the working-class figures.

As a result of the ballot taken during the meeting the candidates named below were unanimously elected Fellows of the Society:—

John Clifford Stanley Hymans, Captain, R.A.

Alfred Kohnstamm.

Louis Moss (also to represent the War Time Social Survey).

*Corporate representatives*

William George Gale Kellett, *representing* the International Rubber Regulation Committee, Brettenham House, W.C. 2.

Stanislas Malessa, *representing* the Planning Office of the Polish Ministry of Labour.

At the meeting on May 9th\* the candidates elected were:—

Cyril John Martin.

Sam M. Orensteen.

Eli Schwartz.

Alfred Ronald Evans Thomas, A.C.I.S.

John Ronald Womersley, B.Sc.

*Corporate representative*

Hendrik Rissik, B.Sc., A.M.I.E.E., *representing* Telephones and Cables, Ltd.

\* In Part II the names of those elected in April were appended in error to the report of the May meeting.

## MISCELLANEA

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SOCIAL AND ECONOMIC CONDITIONS AND THE INCIDENCE OF RHEUMATIC  
HEART DISEASE \*

By G. H. DANIEL, D.Phil.

*Introduction*

DIFFERENCES in health between sections of a population may be reasonably considered as due to differences between them in their hereditary make-up, geographical distribution, or economic and social conditions of life. The latter are likely to affect health in several ways, since they include the nature and amount of nutrition which members of the population obtain, the adequacy of their housing accommodation and clothing, the amount of exposure and toil to which they are subjected, and the degree of medical attention which they receive.

The difficulties in the way of isolating and measuring the factors which determine the incidence of disease are considerable. The phenomena in question are not under the control of the investigator, and the only information which can be secured for analysis is that relating to the existing differences between sections of the population in their constitution, distribution, conditions of life and the incidence of the disease. There is in the first place, therefore, the difficulty of ascertaining which of the many other points of difference are causally associated with the differences in incidence and are specific to the disease. It would be of little use to relate incidence to such an omnibus condition as the degree of urbanization, while, on the other hand, a relation established between the disease and a certain nutritional deficiency would be of practical value. In the second place, a causal relation existing between the incidence of the disease and any one factor—for example, nutrition—is likely to be obscured by the effects of other agencies, such as clothing or housing. It is necessary, therefore, to go beyond the *prima facie* relation between incidence and a particular factor, and to study, as far as possible, the relationship between them when other determining factors are held constant.

It appears from the literature on the aetiology of rheumatic disease that, so far, these difficulties have not been very successfully overcome, and although there is a substantial amount of published work on the subject, the conclusions

\* The present study was suggested by Professor Bruce Perry of the Department of Medicine, Bristol University, who also found which Bristol families contained children suffering from rheumatic heart disease. The data upon which the study is based were collected by the Bristol Social Survey under the guidance of Mr. Herbert Tout. The writer is responsible for analysing the data and preparing the results for publication. Grateful acknowledgment is due to the Medical Research Council and the Colston Research Society for financial assistance, and to the University of Bristol for the facilities afforded for the investigation. Professor M. Greenwood and Dr. J. O. Irwin read the paper in draft and made valuable suggestions.

which can be safely drawn are limited. Several writers have pointed to the existence of large differences in the incidence of rheumatic disease between children in private and children in State schools, between patients attended in private practice and hospital patients, and between children in poor-law schools and those in state schools.\* The two populations in the last of these comparisons were drawn from a similar social and economic class, and may have had a similar hereditary background. But in the other two comparisons the discrepancy in incidence could clearly have been due to differences in hereditary constitution, geographical distribution, or social and economic conditions. The comparisons merely show that these factors between them gave rise to marked differences in incidence and that, on the whole, the poorer classes were associated with the higher incidence.

Other writers have attempted to relate the incidence of rheumatic disease to particular agencies, such as poverty (see, for example, Faulkner and White, 1924, Maddox, 1937, and Miller, 1928), nutrition (Miller and Wilson, 1939, and Vining, 1928), overcrowding (Perry and Roberts, 1937), damp (Coates and Thomas, 1925, Coombs, 1927, Miller, 1926, Newsholme, 1895, Thomson, 1926, and Young, 1925), the distribution of vermin (Clarke, 1928), industrialization (Young, 1921), urbanization (Atwater, 1927, and McCulloch, 1928), and heredity (Hill, 1928, Hill and Allan, 1929, and Sutton, 1928). The Medical Research Council Report of 1927 dealt with the effects of maternal care, subjection to exposure, parents' character, fathers' occupation, income, housing, sanitation, and elevation.

But many of these factors have been inadequately considered in relation to their likely effect on the disease, and others have been so broadly defined as to be useless for practical purposes. There is no obvious reason why parents' character should affect the susceptibility of children to disease, except in so far as it has some influence on the provision of the necessities of life in their homes and thus, indirectly, affects the health of the children. Nor is it of value to find a relation between incidence and the degree of industrialization. Such a relation expresses only the sum effects of a great many specific factors associated together under industrial conditions, some affecting the disease in one way and some in other ways.

In no case does an effort appear to have been made to probe below the surface relations between the incidence of rheumatic disease and the conditions believed to affect it. The net relations—that is, the effects when other factors are constant—have not been examined. Thus Maddox (1937) plotted the location of known cases of rheumatic disease on maps showing climate, relief, distribution of underground water, and poverty, in an attempt to relate the disease to each of these conditions. But, even if the distribution of cases had corresponded closely with that, say, of water, this could have been because the total population, rheumatic and non-rheumatic, was also so distributed, because the people living near the water-courses were the poor, malnourished and susceptible classes, or because infective agencies were concentrated there.

Moreover, the methods employed in establishing relationships have frequently been not only limited but unreliable. Thus Miller concluded that dampness was a determining factor merely from an estimate of the number living in damp

\* See Faulkner and White (1924), Miller (1928), and Medical Research Council (1927). A review of the whole literature is given by Paul (1930).

houses among 196 persons suffering from the disease. The Medical Research Council Report of 1927 sought to evaluate the effects of social and economic conditions by comparing the living conditions of 721 families containing children under hospital treatment for rheumatism with those of 200 families containing children attending hospital on account of non-rheumatic disease. These 200 families, however, included among their other members 43 cases of rheumatism. And, like the rheumatic families, they were families of the hospital class, and belonged presumably to the poorer sections of the community. It is quite possible that their diseases as well as that of the rheumatic families were related to adverse social and economic circumstances. In that case comparison of their conditions as made in the Report of the Medical Research Council could not be expected to reveal the importance of those conditions. The rheumatic families should be compared, not with families suffering from other diseases, but with the total population.

There can be little doubt that an important reason for the slow progress made in the study of the aetiology of rheumatic disease has been the cost of obtaining quantitative data about the condition of a reasonably large number of rheumatic and non-rheumatic families. To a limited extent such information was collected by the University of Bristol Social Survey in 1937. Although it was not the primary object of this Survey, advantage was taken of it to enquire into the relation between the social and economic conditions of life of the Bristol population and the incidence of the disease.

### *The Bristol Data*

In the summer of 1937 the University of Bristol, in conjunction with the Colston Research Society, investigated the circumstances of a random sample of the Bristol working-class population.\* The families considered were those of manual workers, and black-coated workers with incomes not exceeding £5 per week, and information was secured from one family in twenty-two. It was clear that some of the aspects of social and economic conditions about which information was obtained were likely to affect susceptibility to disease. The opportunity was, accordingly, taken of collecting the same information about Bristol families with children suffering from rheumatic disease.

Rheumatic heart disease was chosen as the criterion of rheumatic infection, in order to reduce to the minimum doubts as to correct diagnosis. All cases of working-class children of school age—that is, between five and fourteen years of age—who had shown signs of active rheumatic infection during the eighteen months preceding or covering the period of the Social Survey were investigated for the study. They included the cases discovered by the School Medical Officers during their routine examination and all cases receiving treatment at the two large voluntary hospitals, the children's hospital and the municipal hospitals. The only children not included were those receiving attention from private practitioners, but these were almost certainly above the income limits of the section of the population covered by the enquiry. A small number of the families containing rheumatic children were later found to be middle-class, and a few had moved from Bristol or refused information. The total number of families containing children five to fourteen years of age suffering from rheumatic heart disease and from whom information was obtained was 341.

\* See Tout (1938).

From the sample of the entire working-class population, all families with children five to fourteen years of age were abstracted for comparison with the rheumatic population. The total number of such families was 1,424.

The information collected for both the rheumatic families and the sample of the total population, and which appeared likely to be related to the incidence of rheumatic disease, dealt with income, housing accommodation, membership of a doctor's club, and the receipt of meals or milk at school.

The size of the family income may be expected to affect the children's susceptibility to disease in three ways: the amount of money spent on food may limit the adequacy of their nutrition; the amount spent on clothes and fuel may be related to the degree of exposure; and the outlay on rent and rates may largely determine the nature of their housing accommodation. The Social Survey secured information about the total earnings of each member of the family for the week preceding the date of investigation, and note was made of such items of income as gifts, free clothing, unemployment benefit, and pensions. The outgo on rent and rates, travelling expenses, insurance, trade union subscriptions, and other regular payments was also ascertained. Other expenditures were not investigated, but subtracting the outgo on fixed items from the total family income leaves a residue which was mainly laid out on food, clothes and fuel.\* Lacking more detailed information, the figures for this residue may be related to the incidence of the disease.

It is not, of course, the total family income which is likely to affect susceptibility to disease, as much as the income of the family relative to its needs. It is necessary to adjust the total income according to the size of the family and the age and sex of its members. The minimum needs of each family were evaluated by the Social Survey † according to the age and sex of each member of the family, the standards adopted following, with small modifications, those laid down by George (1937). The net income for each family was expressed as a percentage of its minimum needs, and it is this percentage which is related in the present paper to the incidence of rheumatic heart disease.

Expenditure on rent and rates is known, but its effect on children's susceptibility to disease is unlikely to be close, since rent and rates depend largely on conditions such as location and relations between tenant and landlord which may be little connected with the adequacy of the accommodation from the health point of view. Moreover, because many houses are owner-occupied, the amount paid in rent and rates is not available for all families. The Social Survey found for each family the number of living-rooms and bedrooms occupied by it, and whether or not it possessed a kitchen and bathroom. The total number of these rooms used by each family, divided by the number of persons using them, was taken therefore as a more convenient as well as a more accurate index of housing accommodation.

\* According to the Ministry of Labour's enquiry in 1937 into the expenditure of working-class households, the income left after paying for rent, rates, travelling, insurance and subscriptions was spent as follows:

Food . . . . .	51 per cent.
Clothes . . . . .	14 "
Fuel and Light . . . . .	10 "
Other items . . . . .	25 "

See the *Ministry of Labour Gazette*, December 1940.

† See Tout (1938).

It was also recorded on each of the Survey cards whether any of the living-rooms or bedrooms were situated in a basement, whether the families were members of a doctor's club, and whether the children received meals or milk at school. It was considered that each of these attributes might be related to susceptibility; the use of a basement room because of dampness or lack of light and ventilation, membership of a doctor's club because of the greater opportunities afforded by it for medical attention, and receipt of school meals or milk because of its supplementation of family income. Each of the three attributes enables the population to be divided into two classes, according to possession or non-possession of it, and all three attributes together enable the families to be divided, as shown in Table III, into eight classes.

The incidence of the disease was measured and related to these social and economic conditions by taking each class into which the population could be divided on the basis of net income, housing accommodation, etc., and finding the number of families falling into it among the rheumatic families on the one hand and among the sample of the total population on the other.

The number of rheumatic families in each class was divided by the number of families from the sample of the total working-class population in the same class and, to facilitate comparison of incidence between the classes, the result was expressed as a percentage of the proportion between all 341 rheumatic families and 1,424 families in the total population sample. This gave for each class the incidence of the disease as a percentage of the average incidence among the entire population studied.

The Bristol data thus yields the following information:

(a) Incidence of rheumatic heart disease in each group of working-class families as a percentage of the average incidence for all Bristol working-class families. This will be taken as the dependent variable ( $Y$ ) and for the sake of brevity it will be referred to as the "incidence."

(b) Income available for expenditure on food, clothes and fuel as a percentage of minimum needs. This independent variable ( $X_1$ ) will be referred to simply as the "net income".

(c) Number of rooms per person ( $X_2$ ).

(d) Use of a basement room, receipt of meals or milk at school, and membership of a doctor's club.

#### *Total Relations between Economic and Social Conditions and the Incidence of Rheumatic Heart Disease*

The relation between rheumatic heart disease and conditions of life may be studied by examining, first of all, the association between incidence and each one in turn of the independent variables which have just been described.

In Table I the families are divided among eight net income groups. The second column shows the number of rheumatic families in each group, and the third column the total number of working-class families. The figures of incidence set out in the following column were calculated, as already explained, by dividing the figures in the second column by those in the third and expressing the results as percentages of the average proportion for the whole population.

The figures show a marked relation between net income and incidence; families with incomes below their minimum needs included approximately



TABLE I  
*Incidence of Rheumatic Heart Disease in Relation to Net Income*

Net Income (as a % of minimum needs) (1)	Families with Rheumatic Heart Disease (2)	Families in Sample of Total Working-Class Population (3)	Incidence of Disease (as a % of average incidence) (4)	Expected Incidence * (5)
Under 100 ... ..	77	232	139	142
100-120 ... ..	54	152	148	122
120-140 ... ..	51	191	112	108
140-160 ... ..	33	192	72	97
160-180 ... ..	37	192	81	88
180-200 ... ..	31	149	87	81
200-220 ... ..	17	93	76	75
220 and over ... ..	41	223	77	70
Total ... ..	341	1,424	—	—

\* Estimated from  $Y = 4,291 X_1^{-0.757}$ .

40 per cent. more cases of rheumatic heart disease than did the average working-class families, and approximately twice as many as the working-class families in the highest net income group. These differences in incidence could be due, at least partly, to the smallness of the samples, the proportion of rheumatic heart families in each group being known only from the limited experience of eighteen months, and the distribution of all the working-class families being based on a random sample of one family in twenty-two. The extent to which the differences in incidence can be accounted for in this way may be estimated by calculating the value of  $\chi^2$  from the second and third columns. The value of 21.8 obtained indicates a probability of less than one in a hundred that the differences between the columns can be explained by chance.

If the logarithms of the mid-points of the class intervals in column (1) are plotted on a scatter diagram against the logarithms of the corresponding figures of incidence, the points obtained lie approximately on a straight line. The relationship between the two variables can therefore be represented by an equation of the form

$$\log Y = a - b \log X_1$$

and determining the constants of this equation by the method of least squares we have the relation

$$Y = 4,291 X_1^{-0.757}$$

The last column of Table I shows the incidence expected according to this equation. The coefficient of correlation between the logarithms of the two variables is  $-0.86$  and, assuming random sampling, the standard error of this indicates a probability of ninety-five in a hundred that the correlation in the universe represented by the samples was equal to at least  $-0.5$ .

The relation between incidence and the number of rooms per person may be examined in the same way. Table II presents a classification of the data with respect to rooms per person like that given in Table I with respect to net income. The value of  $\chi^2$  yielded by columns (2) and (3) is 32.5, so that the differences in incidence shown in the fourth column are highly significant. These differences show a clearly defined inverse relation between incidence and rooms per person.

Families with less than 0.6 of a room per person are shown by this table to have had almost four times as many cases as those with 1.8 rooms or more.

TABLE II  
*Incidence of Rheumatic Heart Disease in Relation to the Number of Rooms per Person*

Rooms per Person (1)	Families with Rheumatic Heart Disease (2)	Families in Sample of Total Working-Class Population (3)	Incidence of Disease (as a % of average incidence) (4)	Expected Incidence * (5)
Under 0.6 ... ..	52	130	167	187
0.6-0.8 ... ..	69	193	149	136
0.8-1.0 ... ..	53	194	114	107
1.0-1.2 ... ..	73	335	91	89
1.2-1.4 ... ..	59	303	81	76
1.4-1.6 ... ..	10	71	59	66
1.6-1.8 ... ..	19	138	58	59
1.8 and over ... ..	6	60	42	53
Total ... ..	341	1,424	—	—

\* Estimated from  $Y = 95.1 \cdot X_2^{-1.037}$ .

The relation between the two variables is closely represented by the equation

$$Y = 95.1 \cdot X_2^{-1.037}$$

which indicates that a given percentage difference in the number of rooms per person was accompanied by an almost equal percentage difference in incidence. Relating the logarithms of the two variables, we have a coefficient of correlation of  $-0.97$  and there is a probability of ninety-five in a hundred that the correlation in the universe was equal to at least  $-0.87$ .

Table III displays the eight classes into which the population may be divided

TABLE III  
*Incidence of Rheumatic Heart Disease in Relation to Membership of a Doctor's Club, Receipt of School Meals or Milk, and the Use of Basement Rooms*

Classification of Families	Members of a Doctor's Club				Not Members of a Doctor's Club			
	Receiving School Meals or Milk		Not Receiving School Meals or Milk		Receiving School Meals or Milk		Not Receiving School Meals or Milk	
	No Basement Rooms (1)	Base-ment Rooms (2)	No Base-ment Rooms (3)	Base-ment Rooms (4)	No Base-ment Rooms (5)	Base-ment Rooms (6)	No Base-ment Rooms (7)	Base-ment Rooms (8)
Families with Rheumatic Heart Disease ... ..	4	—	—	—	224	23	84	6
Families in Sample of Total Population ... ..	51	2	5	—	980	60	307	19
Incidence ... ..	33 ± 21	—*	—*	—*	95 ± 5	160 ± 51	114 ± 16	132 ± 83

\* Insufficient data.

according to receipt or non-receipt of meals or milk at school, membership or non-membership of a doctor's club, and use or non-use of a basement for living or sleeping purposes. The advantage of this manifold classification is that it shows the relation between incidence and each attribute independently of the other attributes. Unfortunately, the data are too scanty to enable full use to be made of the table, there being hardly any observations in the second, third and fourth columns. In some of the remaining columns the numbers of families are so small that comparison must necessarily be tentative and no certain conclusions can be drawn.

Despite the smallness of the samples, however, the differences between the first and second rows appear too great to be due entirely to chance since calculation of  $\chi^2$  yields a value of  $P$  slightly less than 0.05. Because it is necessary to consider the differences in incidence between each column, the figures of incidence have had attached to them their standard errors. These errors arise from the fact that both the number of families in the total working population and the number of rheumatic heart families in each column are known only from two limited samples drawn at random.

Comparison of columns (1) and (5) suggests that membership of a doctor's club was associated with a low incidence. Taking columns (5) and (7) for comparison on the one hand, and columns (6) and (8) on the other, it does not appear that receipt or non-receipt of school meals or milk was associated with differences in incidence. Examining column (5) against column (6), and also (7) against (8), families living or sleeping in basements had a higher incidence than those which did not, but the differences are not statistically significant.

The Medical Research Council study of 1927, as already mentioned, compared hospital-class families containing children suffering from rheumatic disease with families of the same class suffering from other diseases. The two groups of families were divided into three classes according to their average total income. No direct relation between the disease and income was discovered, and incidence was in fact found to be lowest among the families with less than 35s. per week and highest among those in the middle income group with 35s. to 59s., although the differences were in each case not significant. Criticism of the choice of two hospital-class groups of families for comparison has already been made, and it may be further objected that the comparison was made with respect to total income, and did not take into account differences in the needs of the families concerned. The conclusion reached in the Medical Research Council Report that there is no direct relation between the occurrence of rheumatic heart disease and poverty, and even the finding that incidence is highest in the middle income ranges of the working-class population, has been widely accepted in subsequent literature. The Bristol data show, however, that after adjustment has been made for needs there is a simple inverse relation between incidence and the income left after paying for rent, rates, travelling and other fixed expenses.

The Medical Research Council Report also dealt with the number of rooms used by the families examined and with the use of basement rooms. No significant relation was found between either of these and the disease. But the present data suggest that there is a close and important relation between incidence and the number of rooms per person, and there may also be a relation between it and the employment of basement accommodation.

The present findings agree with those of Perry and Roberts (1937). These

writers related the number of cases of rheumatic heart disease per 100,000 population with the density of persons per room in 23 Bristol City Wards during the three years 1927-30. They found a simple and significant relation and obtained a coefficient of correlation of 0.84.

*Partial Relations between Social and Economic Conditions and the Incidence of Rheumatic Heart Disease*

The question arises whether the relations found between incidence and each in turn of the three independent variables exist when the remaining two independent variables are held constant.

In Table IV are shown 27 figures of incidence and the corresponding values of net income and rooms per person. To prepare it, the rheumatic heart families and the families in the total working-class population were divided among the 120 classes obtained by taking ten classes of net income and twelve of rooms per person. Classes containing not more than 30 families from the sample of the total population were combined with adjacent classes until they

TABLE IV

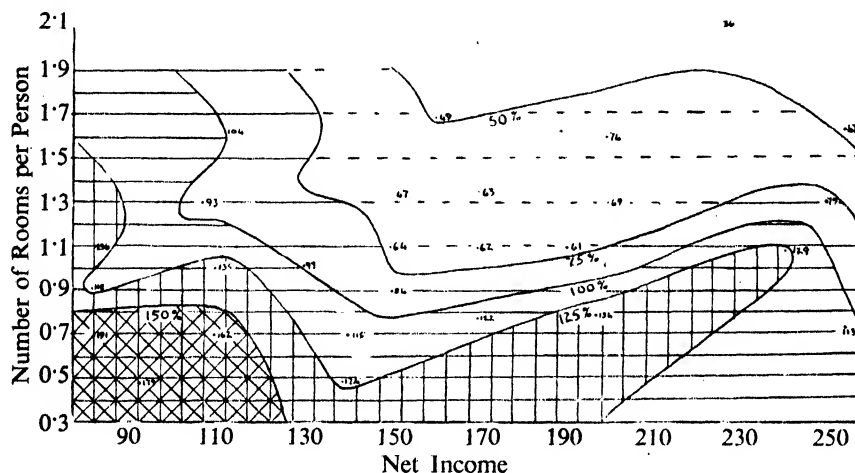
*Incidence of Rheumatic Heart Disease in Relation to Net Income and Number of Rooms per Person*

Net Income (1)	Number of Rooms per Person (2)	Actual Number of Rheumatic Heart Families (3)	Number of Families in Total Population Sample (4)	Actual Incidence (as % of average incidence) (5)	Expected Incidence * (6)	Expected Number of Rheumatic Heart Families * (7)
93	0.47	33	77	179	202	37
140	0.48	11	37	124	168	15
82	0.70	22	48	191	159	18
110	0.70	12	31	162	141	11
82	0.90	11	39	118	132	12
140	0.70	14	51	115	127	16
83	1.10	15	46	136	113	13
110	0.99	22	68	135	109	18
170	0.78	16	55	122	109	14
196	0.77	16	50	134	103	12
150	0.90	6	30	84	103	7
130	1.05	23	97	99	97	23
254	0.74	10	37	113	96	8
107	1.30	19	85	93	90	18
150	1.10	6	39	64	89	8
170	1.10	7	47	62	84	9
190	1.10	7	48	61	81	9
150	1.33	9	56	67	77	10
111	1.67	10	40	104	74	7
239	1.10	16	52	129	73	9
170	1.35	10	66	63	72	11
200	1.30	11	67	69	70	11
249	1.30	10	53	79	64	8
162	1.77	4	34	49	62	5
199	1.62	9	51	74	59	7
255	1.65	7	62	47	53	8
224	2.11	5	58	36	47	6

\* Estimated from  $Y = 757.3 X_1^{-0.414} \cdot X_2^{-0.742}$ .

had the requisite number of families. For groups made up in this way, the values of net income and rooms per person were found by taking the average of the class-marks of the constituent sub-groups, each class-mark being weighted by the number of families belonging to the sample of the total population. The incidence in each of the 27 classes was measured, as already described, by dividing the number of rheumatic families in each class by the total number of families in it, and expressing the result as a percentage of the proportion between all the 341 rheumatic families and the 1,424 families in the sample of the working-class population. A  $\chi^2$  test based on columns (3) and (4) in the table gave a value of  $P$  equal to less than 0.01, so that the differences in incidence are significant.

The nature of the relation between incidence and both net income and number of rooms per person is shown graphically below. The 27 points marked in the figure represent the values in the table, and each point has been located with reference to the values for net income and rooms per person. Contour lines have been drawn in relation to the values of incidence for each point.



Relation between the Incidence of Rheumatic Heart Disease and Net Income and Number of Rooms per Person

These lines show that the incidence of the disease was highest when net income was low and when, at the same time, there were few rooms per person. At any given income level, the incidence tended to vary inversely with the number of rooms per person; conversely, with a given number of rooms per person, the incidence tended to increase as net income diminished.

It was seen in the preceding section that the total relations considered there could be represented by logarithmic equations. Calculating the constants to these equations from the 27 sets of values in Table IV, we have:

$$Y = 3,248 X_1^{-0.710} \text{ and } Y = 95.5 X_2^{-0.885}$$

and the coefficients of correlation\* between incidence and each of the two independent variables are  $r_{12} = -0.59$  and  $r_{13} = -0.78$ .

\* It is to be expected that these coefficients should differ from the ones found in the preceding section since the values of incidence at 27 points are based upon considerably fewer families in each class than are the values at eight points. The errors in the former are accordingly greater and tend to reduce the correlation coefficients.

The relations between all three variables may be analysed by fitting to the same data a logarithmic equation of the form

$$\log Y = a + b_{12.3} \log X_1 + b_{13.2} \log X_2$$

Finding the values of the constants which make  $\Sigma(\log Y - \log Y')^2$  a minimum (where  $\log Y$  = logarithms of the actual figures of incidence and  $\log Y'$  = logarithms of incidence as estimated from the equation) we obtain the partial regression equation

$$Y = 757.3 X_1^{-0.111} \cdot X_2^{-0.742}$$

From this it appears that, when there was no difference in the number of rooms per person, a given percentage difference in net income was accompanied by a difference of 0.414 times as much in incidence. On the other hand, among families with the same net income, those with a given percentage of rooms per person more than the others had 0.742 times less incidence.

The new equation enables incidence to be explained more closely than before. Squaring the correlation coefficients  $r_{12} = 0.59$  and  $r_{13} = 0.78$ , we see that the variation in net income alone could account for 35 per cent. of the variation in incidence, while the differences in rooms per person could explain 61 per cent. The coefficient of multiple correlation is 0.83, so that by employing both independent variables, it is possible to account for 69 per cent. of the variance in incidence. When it is reflected that a large part of the total variance must be attributed to the errors in the values of incidence occasioned by the smallness of the samples, this percentage must be considered a high one. The accuracy with which the partial regression equation enables the differences in incidence of rheumatic heart disease to be estimated is shown in another way in Table IV. There, the numbers of rheumatic heart families are given which could be expected from the equation. From columns (3) and (7),  $\chi^2$  is found to be equal to 7.23,  $P$  is greater than 0.995, and the equation thus enables a very close estimate to be made of the number of affected families.

The partial regression coefficients provide an answer to the question whether there is a significant relationship between the disease and each one of the two independent variables when the effects of the other are held constant. The coefficients, together with their standard errors, are:

$$b_{12.3} = -0.414 \pm 0.144$$

$$\text{and } b_{13.2} = -0.742 \pm 0.136$$

Both are significant. Again, the partial correlation coefficients are:

$$r_{12.3} = -0.50$$

$$\text{and } r_{13.2} = -0.74$$

Fisher's  $z$ -test shows these to be significant, so that it may be presumed that in the universe from which the samples were taken there is a correlation between the incidence of the disease and each of the factors net income and rooms per person when any (linear logarithmic) tendency of the other to obscure the relation is eliminated.

The differences, however, between the partial regression coefficients ( $b_{12.3}$  and  $b_{13.2}$ ), and also between the partial correlation coefficients ( $r_{12.3}$  and  $r_{13.2}$ ), are not significant. It is not possible to say from the Bristol data whether differences in number of rooms per person had a greater or smaller effect on the variation in incidence than had differences in net income.

The association found in Table III between incidence and membership of a doctor's club, receipt of meals or milk at school, and use of a basement room could perhaps be due to the existence of relationships between these attributes and net income or rooms per person, and between the latter and incidence. Of the eight classes into which the families can be divided according to possession or non-possession of the three attributes, the five which contain a reasonable number of families are shown again in Table V. The top row gives the average net income of the families in each class; the second shows the average number of rooms per person; and in the third row the figures of incidence obtained in Table III are repeated.

TABLE V

*Incidence of Rheumatic Heart Disease in Relation to Membership of a Doctor's Club, Receipt of School Meals or Milk, and Use of Basement Rooms (after Approximate Removal of the Effects of  $X_1$  and  $X_2$ )*

Classification of Families	Members of a Doctor's Club	Not Members of a Doctor's Club			
	Receiving School Meals or Milk	Receiving School Meals or Milk		Not Receiving School Meals or Milk	
	No Basement Rooms (1)	No Basement Rooms (5)	Basement Rooms (6)	No Basement Rooms (7)	Basement Rooms (8)
Net Income ... ..	161	160	146	160	161
Rooms per Person ... ..	1.12	1.12	0.94	1.16	1.14
Actual Incidence ... ..	33	95	160	114	132
Incidence Expected from Values of Net Income and Rooms per Person ... ..	100	100	118	97	98
Incidence Adjusted for Differ- ences in Net Income and Rooms per Person ... ..	33	95	136	118	135

Incidence in class (6) was shown in Table III to have been unexpectedly high. The present table indicates that the families in this class had on the whole a relatively low net income and comparatively few rooms per person, and there are also some differences with respect to these conditions between the other classes. From the equation

$$Y = 757.3 X_1^{-0.414} \cdot X_2^{-0.742}$$

the incidence to be expected in each class from the figures of net income and number of rooms per person can be calculated, and the values obtained are shown in the fourth row of Table V.\* With these figures, the actual incidence can be approximately corrected for the differences in net income and number

\* Since this equation was calculated from the logarithms of the values for  $Y$ ,  $X_1$ , and  $X_2$ , the figures of expected incidence obtained from it give an average incidence for the whole population which falls below the arithmetic average (100). The figures were, therefore, multiplied by a constant so that their weighted arithmetic average should equal 100.

of rooms per person, and the adjusted values are given in the bottom row. The correction is only a rough one, since the equation connecting  $Y$  with  $X_1$  and  $X_2$  does not give the relation between these variables net of the effects of the three attributes. A more accurate method was used whereby the families in each of the five classes in the table were further sub-divided according to their net income and the number of rooms per person.\* Forty-one groups were thus obtained, and from these a logarithmic equation relating  $Y$ ,  $X_1$  and  $X_2$  was determined, and the residuals averaged for each of the five classes. First approximations of the effects of the three attributes net of those of net income and rooms per person were secured from these residuals, and the 41 sets of values corrected by means of them. The corrected figures then enabled a more accurate estimate to be made of the net relation between incidence and net income and number of rooms per person, and from this new equation a second approximation was made to the effects of the three attributes. The figures of incidence thus obtained, however, were not substantially different from those given in Table V.

Using, then, the approximation in the last table, we see that adjustment for differences in net income and rooms per person does not substantially alter the relation depicted in Table III. Looking at columns (1) and (5), families which did not belong to a doctor's club appear to have had a substantially higher incidence than those which did. Comparing columns (5) and (6) and also (7) and (8), the use of a basement room is seen to have been associated with a high incidence. On the other hand, columns (5) and (7), and columns (6) and (8), do not show a clear association between the disease and the receipt of school meals or milk.

Finally, the values obtained from the second approximations to the net effects of the three attributes, made, as just described, on the basis of the division of the population into 41 classes, were applied to the figures of incidence. This permitted a still better estimate to be made of the relation between  $Y$ ,  $X_1$  and  $X_2$  net of the effects of the three attributes. But the equation thus calculated did not differ markedly from that first obtained from the 41 sets of values, and there is thus no indication that the relation originally found between incidence net income and rooms per person reflected the association between incidence and the three attributes.

### *Conclusion*

Review of the existing literature on the effect of social and economic conditions on the incidence of rheumatic heart disease shows that most of the analyses made have been limited in scope and productive of few conclusions. It has, however, been demonstrated that marked differences in incidence exist between various social classes, and it has also been shown (Perry and Roberts, 1937) that incidence bears a simple and direct relation to the degree of overcrowding.

The information gathered about the living conditions of the Bristol working-class population shows that:

- (a) Differences in incidence of rheumatic heart disease between sections of this population were associated with differences in the family income available after paying for rent, rates, travelling and other fixed items expressed as a percentage of minimum needs.

\* See Ezekiel, M. (1930), *Methods of Correlation Analysis*, Chapter 17.



(b) Considerable differences in incidence corresponded closely with the variation in the number of rooms used by each family divided by the number of persons in the family.

(c) Families which belonged to doctors' clubs suffered less from the disease than did the remainder of the population.

(d) There is an indication, though the results are not statistically significant, that families which lived or slept in basement rooms included more cases of the disease than other families.

(e) Each one of these relations was true independently of the others.

To what extent these findings based on the Bristol 1937 experience apply to the population of the whole country is unknown. But Bristol is a large town, and there is no apparent reason why the relations found should be confined to it.

If these relationships are causal, a considerable reduction in the incidence of rheumatic heart disease could be effected by improvements in living conditions. The figures in Table V enable an estimate to be made of the effect of raising the net income and increasing the housing accommodation of the poorer families. The values in column (7) sum up the combined influence of net income and rooms per person, and may be taken as a measure of the poverty of the families in both respects. A calculation was made by arranging the 27 sets of figures in the table in order according to the expected incidence. The number of families given in columns (3) and (4) were then cumulated, so that the total number of families and the number of rheumatic heart families with living standards equal to, or above, a given level, as measured in column (7), were known. It was then possible to find the number of cases of the disease to be expected if the entire population had had the same living conditions as the families considered, to calculate the percentage reduction in incidence, and, by graphical interpolation, to find the figures below:

Percentage of the Population with the lowest Net Income and fewest Rooms per Person	Percentage Reduction in Incidence of Disease due to Improvement in Standards of the Poorest Families
10	8
30	21
50	29
70	37
90	49

Thus, if the standards of the 30 per cent. of the Bristol working-class population with the most inadequate incomes and housing accommodation were raised to the average level of the rest of the working-class population, a decrease of 21 per cent. in the number of cases of rheumatic heart disease could be expected. And if standards were raised to the level of the highest 10 per cent. of all working-class families, the incidence of the disease would be roughly halved.

Whether income and housing conditions actually determine the incidence of the disease in this way is not, however, established by the statistical relationships which have been revealed in preceding sections of this paper. It is necessary to consider whether these relations can be accounted for in other ways.

The data collected by the Bristol Social Survey throw no light on the effects of differences in geographical environment or in hereditary constitution. But the variations in altitude, soil, climate, etc., within the City of Bristol are minute, and could hardly account for the relationships we have found. Explanation

in terms of heredity is equally difficult, since it would require that families with an inherited tendency towards rheumatism should tend to have low net incomes, and also to have poor housing conditions and refrain from joining doctors' clubs.

The present information relates only to families with children of school age. All of these children attended State schools and, outside their homes, their environment could have differed comparatively little. Thus, not only are the present results unlikely to have been due to the influence of hereditary or geographical agencies, but the possible effects of occupational differences, which in the case of adults might have complicated those of income and housing, have been avoided.

Again, in this investigation we have been concerned not with the individual children suffering from rheumatic heart disease, but with the families containing such children. Rheumatic disease may be infective. If so, the proportion of children in a family suffering from it would tend to be greater in large families than in small. Since size of family is an important cause of poverty and inadequate housing accommodation, there is, therefore, a possibility that a correlation disclosed between incidence and net income or between incidence and rooms per person could be due merely to the increased likelihood of infection in large families and the tendency for such families to have low standards of living. This possibility has been guarded against by confining examination to family units and giving those with three children suffering from the disease the same weight as those with only one.

The independent variables which have been considered are of broad scope, and exactly how they affect incidence it is not possible to say. Net income, for instance, may be related to the disease, because it limits the consumption of certain essential foodstuffs, or because it determines the adequacy of clothing or heating. New and detailed enquiries would be necessary to isolate the specific factors involved. What the present investigation shows is that rheumatic heart disease appears to be in large part a social disease, and that considerable differences in its incidence are attributable to conditions associated with: (a) the income available after deduction of rent, rates, travelling and other fixed payments; (b) the number of rooms available per person; (c) the membership of doctors' clubs; and, (d) though less certainly, the use of basement rooms.

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## THE ESTIMATION OF MANY PARAMETERS

By R. C. GEARY

THE following theorem is here proved:—

*In an infinite universe there are  $k$  frequency grades,  $k$  being arbitrary, the probability for the  $i$ th grade being  $p_i$ . The  $p_i$  are functions of known form of  $h$  parameters  $\theta_1, \theta_2, \dots, \theta_h$  of which the first partial derivatives all exist. In indefinitely large random samples the estimates of the parameters derived from the maximum likelihood equations are those which minimize the generalized variance.*

This is a generalization of R. A. Fisher's theorem (1922, 1935) for one parameter. The method used generalizes that of Fisher (1935). The concept of *generalized variance* is due to S. S. Wilks (1932).

Let the sample number be  $n$  and the number found in the  $i$ th grade  $nx_i$ ,  $i = 1, 2, \dots, k$ , so that

$$\sum_{i=1}^k x_i = 1$$

$$Ex_i = p_i, i = 1, 2, \dots, k.$$

The probability of a given sample is

$$\frac{1}{n!} \prod_{i=1}^k (nx_i)! p_i^{nx_i}, \quad \dots \quad (1)$$

where  $p_{i0}$  are the values of  $p_i$  for the true, but presumed unknown, values  $\theta_{j0}$  of the parameters. The maximum likelihood estimates of the parameters are the solutions  $\theta_j(x_1, x_2, \dots, x_k)$  of the  $h$  equations

$$\sum_{a=1}^k x_a \frac{\partial}{\partial \theta_j} (\log p_a) = 0, i = 1, 2, \dots, h, \quad \dots \quad (2)$$

where the  $x_a$  are the values for a particular sample.

Suppose that in general an equation for estimating the parameters from the sample values of the  $x_i$  is of the form

$$F(x_1, x_2, \dots, x_k; \theta_1, \theta_2, \dots, \theta_h) = 0, \quad \dots \quad (3)$$

where  $F$ , the  $\frac{\partial F}{\partial x_i}$  and  $\frac{\partial F}{\partial \theta_j}$  for  $x_i = p_i$  ( $i = 1, 2, \dots, k$ ) and  $\theta_j = \theta_{j0}$  ( $j = 1, 2, \dots, h$ ) are supposed to exist, the function being otherwise arbitrary. When  $n$  is large and none of the  $p_i$  is small the variations in the  $x_i$  from  $p_i$  and in the  $\theta_j$  from  $\theta_{j0}$  will be of order  $n^{-\frac{1}{2}}$  and the equation (3) may be written in the form

$$\sum_{i=1}^k m_i x_i = 0 \quad \dots \quad (4)$$

Accordingly any  $h$  equations of type (3) for estimating the values of the parameters, when the sample number is indefinitely large, may be assumed to be of the form

$$X = \sum_{a=1}^k m_{ia} x_a = 0, i = 1, 2, \dots, h, \quad \dots \quad (5)$$

where the  $m_{ia}$  are functions of known form\* of  $\theta_1, \theta_2, \dots, \theta_h$ , which with their

\* The  $m_{ia}$  are linear in the  $\theta_j$ , to the approximation required.



for the maximum likelihood equations. Accordingly, it is necessary to show that

$$\left| \sum_{a=1}^k m_{ia} m_{ja} p_a \right| \left/ \left| \sum_{a=1}^k m_{ia} p_a^{(j)} \right|^2 \right. > 1 \left/ \left| \sum_{a=1}^k \frac{p_a^{(i)} p_a^{(j)}}{p_a} \right|^2 \right. . \quad (15)$$

Since the matrix

$$\begin{vmatrix} \left\| \sum_a m_{ia} m_{ja} p_a \right\| & \left\| \sum_a m_{ia} \frac{p_a^{(j)}}{p_a} \cdot p_a \right\| \\ \left\| \sum_a m_{ia} \frac{p_a^{(j)}}{p_a} \cdot p_a \right\| & \left\| \sum_a \frac{p_a^{(i)} p_a^{(j)}}{p_a} \cdot p_a \right\| \end{vmatrix}$$

of order  $2h$  is positive definite, except when there are linear relations

$$\sum_{i=1}^k \left( m_{ia} \alpha_i + \frac{p_a^{(i)}}{p_a} \beta_i \right) = 0, \quad a = 1, 2, \dots, k,$$

between the expressions involved, the result (15) follows at once from the theory of compound matrices; the writer is indebted for this reference to S. S. Wilks and J. F. Daly (1939).

From (8) and (10) it is evident that for indefinitely large samples the  $\delta 0_j$  are distributed on the normal surface of error. From the expression which Wilks (1932) has given for the moments from zero of the generalized variance, the first four semi-invariants have been calculated to be approximately as follows, where the number of sets of observations of the  $\delta X_i$  ( $i = 1, 2, \dots, h$ ), and hence of the  $\delta 0_j$ , is  $N$ :—

$$\begin{aligned} \lambda_1 &= \Delta = |E(\delta 0_i \delta 0_j)| \\ \lambda_2 &= 2h\Delta^2/N \\ \lambda_3 &= 4h(3h-1)\Delta^3/N^2 \\ \lambda_4 &= 16h(2h-1)(4h-1)\Delta^4/N^3 \end{aligned} \quad (16)$$

These values show that  $\sqrt{B_1} (= \lambda_3/\lambda_2^3)$  and  $B_2 - 3 (= \lambda_4/\lambda_2^2)$  tend towards their normal values zero when  $N$  tends towards infinity. It would be useful to have a complete proof of the approximate normality of the generalized variance for large  $N$ . Wilks (1932) has given an expression for the frequency in the form of a  $h-1$ -dimensional integral.

The theorem here proved may be compared with that of Wilks and Daly (1939) which, in the conditions here assumed as regards the infinite graded parent universe, is as follows. Let

$$\begin{aligned} L_i &= n \sum_{a=1}^k x_a \frac{\partial}{\partial \theta_i} (\log p_a) \\ H_i &= n \sum_{a=1}^k x_a m_{ia} \\ \tilde{L}_i &= \sum_{j=1}^k a^{\theta} L_j \\ \tilde{H}_i &= \sum_{j=1}^k b^{\theta} H_j \end{aligned}$$

where the  $a^{\theta}$  and  $b^{\theta}$  are defined by the matrices

$$\begin{aligned} ||E(L_i L_j)|| &= ||a^{\theta}||^{-2} \\ ||E(H_i H_j)|| &= ||b^{\theta}||^{-2} \end{aligned}$$

Then these authors prove that

$$\left| E\left(\frac{1}{n} \frac{\partial \tilde{L}_i}{\partial \theta_j}\right) \right| \geq \left| E\left(\frac{1}{n} \frac{\partial \tilde{H}_i}{\partial \theta_j}\right) \right|$$

under general conditions. All the functions involved in the  $\theta_j$  have their true values  $\theta_{j0}$ .

Though in appearance the theorem of Wilks and Daly is very different from that here proved the results are fundamentally the same in algebra because both depend essentially on the determinantal inequality at (15) above. The present theorem may, however, have some interest in its being an obvious generalization of the well-known result of R. A. Fisher (1935).

The determinantal inequality may also be used to generalize another well-known theorem in Fisher's classical 1922 paper. Let  $x_1, x_2, \dots, x_h$  and  $y_1, y_2, \dots, y_h$  be two sets of estimates of  $\theta_1, \theta_2, \dots, \theta_h$  so that

$$Ex_i = Ey_i = \theta_i, i = 1, 2, \dots, h.$$

Furthermore, let the  $2h$  variates be distributed on the normal surface of error. Then if the  $x_i$  be sufficient statistics in regard to the  $\theta_h$  and if the  $y_i$  be not sufficient statistics the generalized variance of the  $x_i$  is less than the generalized variance of the  $y_i$ .

By hypothesis the probability density is

$$C \exp. -\frac{1}{2} \left( \sum_{i,j=1}^h A_{ij}(x_i - \theta_i)(x_j - \theta_j) + 2 \sum_{i,j=1}^h B_{ij}(x_i - \theta_i)(y_j - \theta_j) + \sum_{i,j=1}^h C_{ij}(y_i - \theta_i)(y_j - \theta_j) \right); \dots \quad (17)$$

where the coefficients are the elements of the matrix  $D^{-1}$  where  $D$  is given by

$$D = \begin{vmatrix} a_{11} & \dots & a_{1h} & b_{11} & \dots & b_{1h} \\ \vdots & & \vdots & \vdots & & \vdots \\ a_{h1} & \dots & a_{hh} & b_{h1} & \dots & b_{hh} \\ b_{11} & \dots & b_{h1} & c_{11} & \dots & c_{1h} \\ \vdots & & \vdots & \vdots & & \vdots \\ b_{1h} & & b_{hh} & c_{h1} & \dots & c_{hh} \end{vmatrix} \dots \dots \dots \quad (18)$$

in which

$$a_{ij} = E(x_i - \theta_i)(x_j - \theta_j) = a_{ji}; \\ b_{ij} = E(x_i - \theta_i)(y_j - \theta_j); c_{ij} = E(y_i - \theta_i)(y_j - \theta_j) = c_{ji},$$

so that the determinant of  $D$  is the generalized variance of  $x_i, y_j$  together and the top and bottom principal minors of order  $h$  are the generalized variances of the  $x_i$  and the  $y_j$  respectively. Since the quadratic form at (17) is positive definite

$$|A_{ij}| \times |C_{ij}| > |B_{ij}|^2 \dots \dots \dots \quad (19)$$

As the  $x_i$  are sufficient statistics the joint probability density of the  $x_i$  and  $y_j$  must be of the form

$$F(x_1, x_2, \dots, x_h; \theta_1, \theta_2, \dots, \theta_h) \times G(x_1, x_2, \dots, x_h, y_1, y_2, \dots, y_h)$$

Hence the partial derivatives in regard to the  $y_j$  of the logarithm of the probability density must be independent of the  $\theta_i$ . Partially differentiating the

quadratic form at (17) in regard to  $y_i$  and in the resulting expression setting the coefficient of  $\theta_j$  equal to zero, it is found that

$$B_{ij} = -C_{ij}.$$

Substituting in (19) the inequality becomes (since the determinant  $|C_{ij}|$  is positive)

$$|A_{ij}| > |C_{ij}| \quad . \quad . \quad . \quad . \quad . \quad . \quad (20)$$

By Jacobi's theorem

$$\begin{vmatrix} A_{ij} \\ C_{ij} \end{vmatrix} = D^{-1} \begin{vmatrix} c_{ij} \\ a_{ij} \end{vmatrix}$$

and

so that, since  $D$  is positive,

$$|a_{ij}| < |c_{ij}| \quad . \quad . \quad . \quad . \quad . \quad . \quad (21)$$

from (20). These are the respective generalized variances of the  $x_i$  and the  $y_j$ .

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## LAND UTILIZATION IN RURAL AREAS

THE Majority and Minority Reports of the Committee on *Land Utilization in Rural Areas*\* throw an interesting light on the complexity of the problems likely to be met with in a planning of the countryside. A few statistics may be quoted.

The density of the population in relation to the land area in this country is higher than anywhere in Europe, higher even than in Belgium, which is often quoted as the world's most densely populated national area. Taking England alone, there were in 1939 766 people per square mile, as compared with 702 in Belgium, 633 in Holland, 347 in Germany, 345 in Italy and 197 in France. In England and Wales together the figure was 703. This population is preponderantly urban. The census returns of 1931 showed that over 80 per cent. lived in areas classified as "urban" for local government purposes, and even this high figure needs to be increased in view of the fact that there are many small towns in districts classified as "rural." On the other hand, the density of the population in the countryside of England and Wales is certainly less than the countrysides of Holland or Belgium. Making allowance for small towns in rural districts, it is thought that the total population living outside towns is probably somewhere about 6 million, of whom the population living in small, loosely-knit hamlets, in single standing farmhouses and isolated cottages is probably 2 to 2½ million, while the population in villages is probably 3½ to 4 million.

As regards the extent of land used directly and indirectly in housing the population, it is estimated that in 1937 some 4,162,000 acres of land in England and Wales were occupied by towns, villages, houses and buildings of all kinds, and by roads, railways, canals, docks, harbours, aerodromes, sewerage works, cemeteries and industrial waste spaces. Thus, with a total population of 41 million there were 10 people per "developed" acre. Expressed briefly, the uses to which the 37,133,000 acres of land in England and Wales were being put in 1937 were as follows: some 82·1 per cent. was employed in agricultural production (including rough grazings); 1·1 per cent. was open land of various kinds not being used for agriculture, including playing-fields, commons, etc.; 5·5 per cent. was woodland; and the remaining 11·3 per cent. was covered by buildings, roads and various other forms of constructional development, or was otherwise unaccounted for in the returns. These areas are, of course, slowly changing year by year, the area devoted to agriculture diminishing as land is handed over for building or other uses; in the 12 years 1927-39, some 795,000 acres of agricultural land were absorbed by building development and other purposes, or about 66,000 acres per annum. During the war, the loss of productive agricultural land has increased considerably, mainly owing to the needs of the Service Departments. The number of houses built in those 12 years is not given, but in the 20 years between 1919 and 1939 it is estimated that some 3,800,000 habitations of all kinds were erected outside town areas on rural—that is to say, agricultural—land.

The Report gives a summary of the general agricultural position, and remarks that though the majority of the population lives in towns, agriculture considered as an industry is not only the dominant interest of eight-ninths of the country's area, but provides work directly for nearly a million people, and indirectly for

\* Stationery Office, Cmd. 6378. Price 2s. net.

many more in the industries catering for its needs. The total value of agricultural and horticultural produce sold off farms in 1935-6 was £205 million, a figure which may be compared with the production of minerals which is officially put at £165 million in the same year.

A map showing changes in population 1931-38, prepared by the Ministry of Works and Planning, shows very clearly that losses of population have occurred in nearly all parts of rural England and Wales. With a few exceptions, all the great increases were in the broad central belt from South Lancashire to London and the South-East, especially in the areas surrounding the great population centres of Liverpool, Manchester, Birmingham and Greater London. The centres of these urban areas show relative depopulation as the people have moved outwards. Much of this population expansion has been on the best agricultural land, or at least on agricultural land classed as "good," and it is pointed out that in the past little or no regard has been paid to agricultural considerations in selecting land for development: neither the quality of the land nor the effect on surrounding farms has been taken into account.

The main Report visualizes the establishment of a central planning authority and assumes that Government policy includes the maintenance of a prosperous agriculture, the resuscitation of village and country life and the preservation of amenities. It makes a large number of recommendations directed to these ends, particularly that a big building programme should be undertaken after the war. One of the basic assumptions on which the Report is based is "the maintenance of a healthy and well-balanced agriculture," a phrase which the Committee interpret to mean the continuance and revival of the traditional mixed character of British farming. The well-being of rural communities and the preservation of rural amenities, they say, are dependent on this, and no conditions imposed on constructional development in the countryside will be effective unless agriculture is in a healthy condition. The implications involved in this view are, however, contested by Professor Dennison in his Minority Report, in which he discusses from an economic point of view questions of acreage, employment and output. He points out that the ultimate prosperity of agriculture must depend on increased efficiency, and that one of the ways in which this may be attained may be by greater specialization, and not by the continuance and revival of traditional farming. Among the many problems connected with the "maintenance of agriculture," attention is drawn to the position as regards agricultural wages: the effect of the minimum wage of 60s. per week is not at present felt by the farmer nor directly by the consumer, because it is financed by the Exchequer in the form of prices fixed on a basis of costs. Increased prices to the consumer are avoided by a stabilization policy costing £135 millions a year, which consumers in the form of taxpayers have to bear. The Government has announced that agricultural prices will be maintained for at least one year after the war, to allow agriculture a breathing-space for readjustment, but this is not a promise that subsidies of the present magnitude will continue indefinitely. The latter, Professor Dennison remarks, would involve the imposition of a burden on the rest of the community which it might not permanently consent to bear.

R. J. T.

## WHOLESALE PRICES IN 1941

BY THE EDITOR OF "THE STATIST"

(The Statist's Index Numbers in continuation of  
Mr. A. Sauerbeck's figures)

IN Table I below are set out the Sauerbeck-*Statist* annual index-numbers for each year from 1846 to 1941, Jevons' figures for 1810 and 1818, adjusted to Sauerbeck's standard, being also included. These index-numbers, based on averages for the period 1867-77, are calculated (with few exceptions) from the average of weekly quotations throughout each year for the forty-five commodities which they cover. Up to the end of 1912 they were calculated by the late Mr. Augustus Sauerbeck. Since that date they have been compiled by *The Statist*.

In 1941 the annual index for all commodities rose by 11 per cent. to 142, this advance being considerably smaller than that of 33 per cent. recorded in 1940. Whether this should be treated as testimony to the efficacy of price controls, or as a reminder that comparison is with figures which had already risen well above the pre-war level, is an open question. But it may be noted that the increase of 11 per cent. shown in the second full year of this war contrasts with an increase of 28 per cent. in the second full year of the last—1916. The end-year figure was 62 per cent. above that for August, 1939, whereas at the close of 1940 an advance of 33 per cent. had been shown on the same comparison.

Month-by-month analysis of the 1940 figures indicated that the proportional increase of the general index over that for 1939 was materially reduced from September onwards—i.e., from the point where the figures for the earlier year had already reflected the impact of war conditions. In 1941 the experience was more even. For January and February the increase, as compared with the same months of 1940, was around 9 per cent.; then came five months in which it was about 12 per cent.; and for each of the last three months of the year it settled down again to 9 per cent.

By quarters these trends worked themselves out in advances of 10 per cent. in the first, 12 per cent. in the second, 11 per cent. in the third, and 9 per cent. in the fourth. The food group showed the widest quarterly variation, the increases here, as compared with the corresponding periods of 1940, being respectively 11 per cent., 14 per cent., 12 per cent., and 11 per cent., whereas the index for industrial materials rose by 10 per cent. in each of the first three quarters and by 8 per cent. in the last.

Once again the index for animal foodstuffs remained very stable, but that for vegetable foods moved upwards fairly strongly. But perhaps of greater interest is that the quarterly progression in the index for minerals, a progression which commenced in the second quarter of 1939, was arrested in the third quarter of 1941. This index moved ahead slightly in the last quarter of the year, but on the other hand the index for textiles, which had been moving upwards from the third quarter of 1938, and that for sundry materials, which had behaved similarly, both fell back. The result was that the quarterly general index receded in November-December for the first time in three years.

TABLE I

THE STATIST'S *Annual Index Numbers* (in continuation of Sauerbeck's figures)  
(1867-77 = 100)

Year	Average No.	Year	Average No.	Year	Average No.	Year	Average No.	Year	Average No.
1941	142	1921	155	1901	70	1881	85	1862	101
'40	128	'20	251	'00	75	'80	88	'61	98
'39	95	'19	206	1899	68	'79	83	'60	99
'38	91	'18	192	'98	64	'78	87	'59	94
'37	102	'17	175	'97	62	'77	94	'58	91
'36	89	'16	136	'96	61	'76	95	'57	105
'35	84	'15	108	'95	62	'75	96	'56	101
'34	82	'14	85	'94	63	'74	102	'55	101
'33	79	'13	85	'93	68	'73	111	'54	102
'32	80	'12	85	'92	68	'72	109	'53	95
'31	83	'11	80	'91	72	'71	100	'52	78
'30	97	'10	78	'90	72	'70	96	'51	75
'29	115	'09	74	'89	72	'69	98	'50	77
'28	120	'08	73	'88	70	'68	99	'49	74
'27	122	'07	80	'87	68	'67	100	'48	78
'26	126	'06	77	'86	69	'66	102	'47	95
'25	136	'05	72	'85	72	'65	101	'46	89
'24	139	'04	70	'84	76	'64	105	'18	159*
'23	129	'03	69	'83	82	'63	103	'10	171*
'22	131	'02	69	'82	84				

\* Jevons' numbers adjusted.

TABLE II

THE STATIST'S *Annual Index Numbers*—ten-year averages (1867-77)

1838-1847	93	1901-'10	73	1918-1927	159
'48-'57	89	'02-'11	74	'19-'28	152
'58-'67	99	'03-'12	76	'20-'29	142
'68-'77	100	'04-'13	77	'21-'30	127
'78-'87	79	'05-'14	79	'22-'31	120
'88-'97	67	'06-'15	82	'23-'32	115
'90-'99	66	'07-'16	88	'24-'33	110
'91-1900	66	'08-'17	98	'25-'34	104
'92-'01	66	'09-'18	110	'26-'35	99
'93-'02	66	'10-'19	123	'27-'36	95
'94-'03	66	'11-'20	146	'28-'37	93
'95-'04	67	'12-'21	148	'29-'38	90
'96-'05	68	'13-'22	153	'30-'39	88
'97-'06	70	'14-'23	157	'31-'40	91
'98-'07	71	'15-'24	162	'32-'41	97
'99-'08	72	'16-'25	165		
1900-'09	73	'17-'26	164		

## Monthly Fluctuations of the Index Numbers\* of 45 Commodities, 1867-77 = 100

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1888	70.9	70.6	69.9	69.8	68.1	67.4	69.0	70.1	71.9	72.4	72.7	73.2	70
1897	62.0	61.9	61.9	61.5	61.2	61.3	61.7	63.2	63.4	62.7	62.4	62.4	62
'98	62.8	63.4	63.0	65.5	66.4	64.7	64.3	64.0	63.9	63.6	63.9	63.8	64
1899	65.4	65.8	65.6	66.1	66.6	66.9	67.9	68.3	70.0	71.5	71.6	72.3	68
1900	74.0	75.1	75.7	75.6	75.5	75.7	76.2	76.0	75.5	74.7	73.9	73.4	75
'01	72.2	71.7	71.0	70.6	70.5	69.8	69.5	69.8	69.6	69.6	69.0	68.4	70
'02	68.8	68.9	69.2	69.7	70.9	70.4	70.0	69.5	69.3	68.8	68.6	69.1	69
'03	69.5	70.2	70.4	69.4	69.6	69.5	69.5	70.0	69.1	69.0	69.0	70.0	69
1904	70.4	70.8	70.8	70.5	69.9	69.4	69.9	70.4	70.7	71.0	71.2	70.9	70
'05	71.2	71.4	71.8	72.0	71.7	72.0	72.5	72.3	72.4	73.2	74.2	74.9	72
'06	75.2	75.0	75.7	76.5	77.0	76.9	76.4	76.7	77.5	78.5	78.6	79.7	77
'07	80.0	80.7	80.0	80.7	82.4	82.0	81.1	79.4	79.1	78.8	76.7	76.2	80
'08	76.0	74.5	74.1	73.8	73.6	72.9	73.1	72.2	72.5	72.2	72.2	72.3	73
1909	72.0	71.9	72.4	74.3	75.4	75.1	75.2	74.9	74.7	75.2	75.5	76.3	74
'10	77.1	78.1	79.1	78.5	78.2	76.9	78.1	78.2	77.6	77.2	77.8	77.9	78
'11	78.5	78.6	78.9	80.0	80.3	80.0	78.9	79.5	80.3	80.7	80.6	80.9	80
'12	81.8	82.9	84.4	85.0	85.3	85.5	86.5	85.9	86.7	85.8	85.3	86.4	85
'13	86.4	86.1	86.7	86.2	85.7	84.1	84.2	85.0	85.7	84.5	83.3	83.8	85
1914	83.5	83.8	82.8	82.3	82.3	81.2	82.4	87.9	89.3	89.8	88.8	91.6	85
'15	96.4	100.9	103.7	105.9	107.2	106.4	106.4	107.0	107.8	110.0	113.1	118.4	108
'16	123.6	127.0	130.4	134.2	135.4	131.0	130.5	134.5	134.4	141.5	150.8	154.3	136
'17	159.3	164.0	169.0	173.0	175.0	180.4	176.9	175.7	176.4	180.6	182.9	185.1	175
'18	186.2	187.3	188.0	189.8	191.1	192.3	192.9	195.9	197.1	197.8	195.3	196.0	192
1919	192.1	187.5	184.7	184.6	194.6	199.4	206.4	212.7	214.8	224.3	231.0	235.2	206
'20	245.3	260.4	261.8	266.1	260.0	255.7	254.6	253.5	248.7	239.9	223.8	207.2	251
'21	197.2	183.0	177.2	169.8	162.2	155.8	158.2	154.3	149.4	138.4	136.7	133.6	155
'22	132.5	132.2	133.3	134.8	135.5	135.6	134.0	129.6	127.9	130.1	130.6	129.1	131
'23	130.2	131.9	132.7	134.0	132.2	127.9	124.8	125.0	127.8	127.7	132.4	133.2	129
1924	137.2	138.8	137.0	136.8	136.4	136.3	138.4	138.0	141.3	146.1	145.5	147.7	139
'25	144.8	143.1	140.1	137.5	135.7	131.2	134.3	134.3	132.7	130.2	132.9	130.4	136
'26	129.3	127.9	126.1	125.5	125.7	124.9	126.0	127.0	128.0	131.0	130.8	123.9	126
'27	123.1	124.1	123.6	123.3	123.8	123.1	122.0	122.8	121.5	120.6	121.5	121.4	122
'28	120.9	121.1	123.6	125.6	126.2	122.6	120.3	118.0	116.8	116.8	117.9	117.9	120
1929	117.0	120.1	120.5	116.5	113.0	113.1	115.2	113.9	112.6	111.1	108.3	108.8	115
'30	106.6	104.8	103.0	101.5	98.8	95.8	94.4	92.2	90.8	90.4	88.6	86.9	97
'31	85.7	85.5	85.5	84.4	82.2	82.6	80.2	79.1	80.7	82.3	83.0	85.4	83
'32	84.7	86.7	84.1	82.5	80.2	77.0	78.9	80.7	80.4	77.8	77.9	77.7	80
'33	77.8	77.0	77.0	78.5	80.9	81.3	81.7	81.2	80.7	80.5	79.3	80.0	79
1934	82.5	82.5	82.2	81.0	81.1	80.7	82.4	83.4	82.1	81.1	81.0	82.8	82
'35	83.6	83.4	82.9	84.1	85.2	83.7	84.3	84.1	85.1	85.8	86.3	86.7	84
'36	87.1	87.1	86.7	86.2	85.6	84.8	87.1	89.0	90.4	91.7	94.5	98.9	89
'37	99.6	102.1	107.3	104.7	106.2	104.7	105.9	104.4	103.3	100.8	96.7	97.3	102
'38	96.5	96.4	94.2	93.5	91.4	91.4	91.1	88.6	88.6	88.8	87.4	89.1	91
1939	88.7	88.6	89.0	90.5	90.6	90.6	88.7	90.4	99.7	105.8	112.2	120.1	95
'40	124.1	124.5	123.4	126.0	128.0	130.0	129.5	131.5	131.6	131.8	132.7	134.5	128
'41	134.9	136.3	138.0	141.1	143.5	144.4	145.3	145.1	145.5	143.7	145.5	146.5	142
'42	148.6	153.4	153.5	154.5	156.6	154.4	150.0	149.4	149.7	150.4			

\* The average of the twelve monthly figures of each year does not necessarily coincide with the annual figures, as the latter are calculated mostly from the average of 52 weekly quotations, while the former are based on end-of-the-month prices.

## Summary of Index Numbers. Groups of Articles, 1867-77 = 100

	Vegetable Food (Corn, etc.)	Animal Food (Meat, etc.)	Sugar, Coffee, and Tea	Total Food	Minerals	Textiles	Sundry Materials	Total Materials	Grand Total	Silver °	Wheat Harvest †	Average Price of Consols ‡	Average Bank of England Rate ‡
1873.....	106	109	106	107	141	103	106	114	111	97.4	80	£ 92½	Percent. 4.750
1896.....	53	73	59	62	63	54	63	60	61	50.5	112	110½	2.483
1911.....	70	90	61	75	93	76	81	83	80	40.4	110	79½	3.467
1915.....	108	126	70	170	126	92	109	108	108	38.9	106	65½	5.000
'16.....	133	152	86	130	158	129	136	140	136	50.4	97	58½	5.470
1917.....	177	192	113	169	172	192	174	179	175	65.8	102	54½	5.15
'18.....	168	207	130	174	192	222	202	206	192	76.4	111	56½	5.0
'19.....	179	213	147	185	220	228	219	222	206	85.3	98	54½	5.166
'20.....	227	263	198	234	295	262	244	264	251	76.1	96	47½	6.71
'21.....	143	218	83	158	181	140	145	153	155	48.1	118	47½	6.092
1922.....	107	184	82	130	142	134	124	132	131	51.6	105	56½	3.692
'23.....	98	162	101	122	155	140	117	134	129	49.4	105	57½	3.496
'24.....	119	158	105	130	158	170	120	146	139	50.7	107	56½	4.0
'25.....	118	162	89	128	154	165	119	143	136	52.5	114	56½	4.575
'26.....	108	150	88	119	154	133	114	131	126	47.1	99	54½	5.0
1927.....	108	138	83	114	141	131	118	129	122	42.8	109	54½	4.650
'28.....	107	142	78	114	123	136	117	124	120	44.0	109	55½	4.5
'29.....	99	146	72	110	126	122	111	119	115	40.2	114	54½	5.508
'30.....	77	142	54	96	112	84	97	97	97	29.0	99	56	3.4
'31.....	68	119	50	83	100	63	85	82	83	20.4	99	55½	3.975
1932.....	72	105	50	79	99	64	81	81	80	19.5	105	66½	3.017
'33.....	60	106	47	74	107	67	80	83	79	18.7	114	73½	2.0
'34.....	63	108	50	77	109	72	80	85	82	20.0	120	80½	2.0
'35.....	66	107	42	76	112	80	83	90	84	26.4	112	86½	2.0
'36.....	76	109	41	81	118	83	88½	94	89	18.5	100	85½	2.0
1937.....	93	117	49	93	142	93	101	110	102	18.4	99	76½	2.0
'38.....	81	111	43	84	136	75	87	96	91	17.6	122	74½	2.0
'39.....	74	115	47	83	137	93	90	103	95	17.1	112	66½	2.5
'40.....	112	141	58	111	167	147	120	141	128	17.1	—	72½	2.0
'41.....	140	142	65	125	181	161	133	155	142	18.0	—	79½	2.0
Average													
1904-13	68	91	53	73	95	74	76	81	77	44.1	106	82½	3.733
890-99	61	80	63	68	71	56	66	64	66	55.8	103	103½	2.958
'78-87	79	95	76	84	73	71	81	76	79	82.1	97	99½	3.264
1818-27	109	90	151	111	128	105	106	112	111	98.0	—	—	3.692

\* Silver (see note on p. 352), parity of 1 gold to 15½ silver = 100.

† Wheat harvest in U.K. to 1895: 29 bushels = 100; from 1896: 30 bushels = 100.

‡ Average price of Consols and the average Bank of England rate of discount are actual figures, not index-numbers; Consols 3% to 1888, 2½% from 1889, 2½% from April, 1903.

THE STATIST'S *Index Numbers—monthly averages by groups*  
(1867-77 = 100)

		Vegetable Food	Animal Food	Sugar, Tea, and Coffee	Food-stuffs	Minerals	Textiles	Sundry Materials	Total Materials	All Commodities
<b>1939</b>										
Jan.	...	68.9	110.9	43.3	<b>79.0</b>	134.8	78.0	84.0	<b>95.9</b>	<b>88.7</b>
Feb.	...	67.7	110.0	43.1	<b>78.2</b>	133.8	80.1	83.9	<b>96.2</b>	<b>88.6</b>
Mar.	...	67.3	111.7	44.1	<b>78.8</b>	133.9	80.7	84.2	<b>96.5</b>	<b>89.0</b>
April	...	66.7	113.2	47.0	<b>79.7</b>	135.1	85.4	84.7	<b>98.5</b>	<b>90.5</b>
May	...	66.3	112.6	46.6	<b>79.2</b>	134.3	85.5	86.2	<b>99.0</b>	<b>90.6</b>
June	...	67.0	113.0	47.0	<b>79.8</b>	133.9	86.3	84.9	<b>98.5</b>	<b>90.6</b>
July	...	61.6	110.6	43.4	<b>76.0</b>	134.3	84.5	84.6	<b>97.9</b>	<b>88.7</b>
Aug.	...	62.2	112.8	44.4	<b>77.1</b>	136.2	87.0	86.6	<b>100.2</b>	<b>90.4</b>
Sept.	...	71.9	127.6	56.5	<b>89.1</b>	136.9	101.7	92.8	<b>107.4</b>	<b>99.7</b>
Oct.	...	85.6	130.3	56.0	<b>95.8</b>	138.1	108.0	100.9	<b>113.1</b>	<b>105.8</b>
Nov.	...	92.3	130.3	58.5	<b>99.2</b>	143.4	124.1	106.4	<b>121.8</b>	<b>112.2</b>
Dec.	...	101.7	130.3	57.6	<b>103.0</b>	158.7	138.4	111.8	<b>132.6</b>	<b>120.1</b>
<b>1940</b>										
Jan.	...	106.2	142.7	57.3	<b>109.4</b>	158.1	142.9	114.1	<b>134.8</b>	<b>124.1</b>
Feb.	...	103.7	140.5	57.5	<b>107.5</b>	161.0	140.8	118.6	<b>136.8</b>	<b>124.5</b>
March	...	102.6	140.5	57.3	<b>107.0</b>	161.2	139.9	115.5	<b>135.3</b>	<b>123.4</b>
April	...	102.7	140.5	57.6	<b>107.0</b>	163.4	145.6	121.1	<b>140.0</b>	<b>126.0</b>
May	...	104.2	140.5	56.9	<b>107.6</b>	166.6	150.7	122.0	<b>142.9</b>	<b>128.0</b>
June	...	117.2	140.5	56.4	<b>113.0</b>	165.7	148.9	123.4	<b>142.6</b>	<b>130.0</b>
July	...	106.5	140.5	58.1	<b>108.8</b>	172.1	150.0	123.1	<b>144.6</b>	<b>129.5</b>
Aug.	...	122.5	140.5	57.8	<b>115.5</b>	170.9	147.5	121.9	<b>142.7</b>	<b>131.5</b>
Sept.	...	122.9	140.5	59.8	<b>116.1</b>	170.2	148.4	121.5	<b>142.9</b>	<b>131.6</b>
Oct.	...	124.6	140.5	59.9	<b>116.8</b>	171.1	150.6	119.1	<b>142.8</b>	<b>131.8</b>
Nov.	...	126.6	140.5	57.6	<b>117.2</b>	173.8	152.1	119.4	<b>144.1</b>	<b>132.7</b>
Dec.	...	131.3	140.5	59.0	<b>119.5</b>	175.5	152.9	121.0	<b>145.5</b>	<b>134.5</b>
<b>1941</b>										
Jan.	...	131.3	140.5	59.1	<b>119.5</b>	176.8	152.9	122.0	<b>146.3</b>	<b>134.9</b>
Feb.	...	130.4	140.5	62.0	<b>119.7</b>	179.2	152.5	125.9	<b>148.4</b>	<b>136.3</b>
March	...	127.7	142.8	64.6	<b>120.0</b>	181.0	159.0	126.2	<b>151.1</b>	<b>138.0</b>
April	...	135.4	142.8	65.0	<b>123.3</b>	180.9	159.7	132.8	<b>154.1</b>	<b>141.1</b>
May	...	138.4	142.8	65.6	<b>124.7</b>	181.5	161.5	138.7	<b>157.2</b>	<b>143.5</b>
June	...	140.0	142.8	65.3	<b>125.3</b>	181.1	163.7	140.2	<b>158.4</b>	<b>144.4</b>
July	...	143.3	142.8	64.4	<b>126.5</b>	182.3	164.5	140.2	<b>159.0</b>	<b>145.3</b>
Aug.	...	145.3	142.8	66.1	<b>127.7</b>	180.5	166.0	137.1	<b>157.7</b>	<b>145.1</b>
Sept.	...	146.5	142.8	65.7	<b>128.1</b>	180.3	166.2	138.2	<b>158.2</b>	<b>145.5</b>
Oct.	...	147.0	142.8	69.0	<b>129.0</b>	181.0	164.8	130.0	<b>154.4</b>	<b>143.7</b>
Nov.	...	150.9	142.8	69.0	<b>130.7</b>	181.6	162.9	135.2	<b>156.2</b>	<b>145.5</b>
Dec.	...	155.3	142.8	68.8	<b>132.5</b>	182.2	161.5	137.3	<b>156.7</b>	<b>146.5</b>
<b>1942</b>										
Jan.	...	163.3	142.8	68.9	<b>135.9</b>	181.5	161.5	140.7	<b>158.0</b>	<b>148.6</b>
Feb.	...	189.8	142.8	69.4	<b>147.1</b>	181.6	161.5	139.6	<b>157.6</b>	<b>153.4</b>
Mar.	...	185.8	147.3	69.5	<b>147.1</b>	181.8	160.4	141.5	<b>158.1</b>	<b>153.5</b>
April	...	187.6	147.3	69.4	<b>147.9</b>	182.4	160.4	144.1	<b>159.4</b>	<b>154.5</b>
May	...	190.0	147.3	69.7	<b>149.0</b>	183.1	160.4	150.3	<b>162.2</b>	<b>156.6</b>
June	...	188.3	147.3	69.6	<b>148.2</b>	181.1	160.4	144.0	<b>159.0</b>	<b>154.4</b>
July	...	159.0	147.3	70.2	<b>136.0</b>	184.7	159.0	144.8	<b>160.0</b>	<b>150.0</b>
Aug.	...	157.9	147.3	71.7	<b>135.8</b>	186.4	158.0	143.1	<b>159.3</b>	<b>149.4</b>
Sept.	...	158.3	147.3	72.2	<b>136.1</b>	186.4	158.0	144.3	<b>159.9</b>	<b>149.7</b>
Oct.	...	156.4	150.4	72.5	<b>136.6</b>	186.9	164.2	141.0	<b>160.5</b>	<b>150.4</b>

## Quarterly Movements of Prices \*

Summary of Index Numbers, 1867-77 = 100

Years	Quar- ters	Vege- table Food (Corn, etc.)	Animal Food (Meat, etc.)	Sugar, Coffee, and Tea	Total Food	Min- erals	Tex- tiles	Sun- dry Mate- rials	Total Mate- rials	Grand Total	Sil- ver †
1930	I	80.8	152.1	58.3	102.3	121.1	96.4	104.9	106.7	<b>104.8</b>	33.0
	II	76.7	142.4	56.5	96.5	110.8	92.4	99.5	100.4	<b>98.7</b>	29.8
	III	77.4	132.1	48.6	91.5	109.0	77.3	94.6	94.6	<b>92.5</b>	26.8
	IV	71.9	130.0	51.7	89.0	105.4	68.9	91.6	88.3	<b>88.6</b>	26.5
'31	I	69.0	127.3	48.6	86.2	103.4	62.7	89.8	85.1	<b>85.6</b>	21.8
	II	<b>69.5</b>	123.3	48.8	85.0	98.6	61.4	85.6	81.7	<b>80.1</b>	21.3
	III	70.0	117.4	47.0	81.4	98.5	58.6	81.6	79.0	<b>83.0</b>	21.9
	IV	75.7	107.9	53.7	82.9	102.2	66.9	85.4	84.1	<b>83.6</b>	21.5
'32	I	80.7	109.2	52.2	83.2	101.1	67.5	87.8	85.2	<b>85.2</b>	21.0
	II	77.6	107.6	50.2	82.9	95.1	59.4	79.6	77.3	<b>79.9</b>	19.4
	III	68.2	105.3	49.6	77.9	100.6	65.9	80.7	81.5	<b>80.0</b>	19.4
	IV	64.2	98.2	48.4	73.4	101.2	64.5	80.2	81.0	<b>77.8</b>	18.4
'33	I	60.2	106.0	47.3	74.4	99.7	62.0	79.1	79.4	<b>77.3</b>	18.2
	II	59.1	108.4	47.4	74.8	109.7	68.7	79.8	84.2	<b>80.2</b>	20.0
	III	62.0	105.8	47.9	75.2	111.0	71.0	80.0	85.6	<b>81.2</b>	18.5
	IV	58.5	106.4	47.4	73.8	110.9	67.7	79.7	84.4	<b>79.9</b>	18.5
'34	I	59.4	110.1	53.0	76.7	111.7	73.6	79.9	86.5	<b>82.4</b>	19.1
	II	58.7	110.3	52.2	76.1	108.4	70.8	79.1	84.4	<b>80.9</b>	18.6
	III	71.0	109.5	48.0	80.4	108.5	70.7	78.7	84.3	<b>82.6</b>	19.7
	IV	66.7	107.3	44.8	77.0	109.7	70.9	79.6	85.0	<b>81.6</b>	22.1
'35	I	64.4	111.2	41.3	76.8	108.9	77.4	82.6	88.0	<b>83.3</b>	23.0
	II	67.1	107.9	42.3	76.9	112.3	79.4	82.8	89.8	<b>84.3</b>	29.3
	III	68.8	106.6	40.6	76.8	113.8	80.1	82.3	90.1	<b>84.5</b>	27.3
	IV	70.7	104.1	41.8	76.9	116.7	83.6	84.9	93.0	<b>86.3</b>	25.7
'36	I	72.1	104.6	41.2	77.6	116.1	84.6	86.4	93.8	<b>87.0</b>	18.2
	II	71.2	107.1	39.7	77.8	114.7	79.4	84.8	91.2	<b>85.5</b>	18.6
	III	75.3	112.6	39.1	81.5	116.7	80.5	90.0	94.2	<b>88.8</b>	18.6
	IV	85.8	110.7	42.6	85.9	129.6	88.2	93.8	101.7	<b>95.0</b>	18.9
'37	I	93.1	112.7	47.1	90.6	144.3	97.4	102.3	112.0	<b>103.0</b>	18.6
	II	94.3	121.0	49.6	94.7	143.5	99.9	102.9	112.8	<b>105.2</b>	18.7
	III	93.3	121.4	50.2	94.6	147.7	94.6	101.4	111.8	<b>104.5</b>	18.4
	IV	95.5	116.3	47.2	93.0	136.3	81.2	95.6	102.1	<b>98.3</b>	18.0
'38	I	92.3	116.4	43.1	90.8	134.8	77.8	92.4	99.3	<b>95.7</b>	18.5
	II	89.2	114.1	42.2	88.5	132.0	73.5	86.5	94.8	<b>92.1</b>	17.4
	III	78.0	107.4	42.9	81.4	135.9	73.9	85.0	95.3	<b>89.4</b>	17.3
	IV	68.8	105.8	43.3	77.1	140.6	74.3	85.1	96.7	<b>88.4</b>	17.4
'39	I	68.0	110.9	43.5	78.7	134.2	79.6	84.0	96.2	<b>88.8</b>	17.7
	II	66.7	112.9	46.9	79.6	134.4	85.7	85.3	98.7	<b>90.6</b>	17.3
	III	65.2	117.0	48.1	80.7	135.8	91.1	88.0	101.8	<b>92.9</b>	15.7
	IV	93.2	130.3	57.4	99.3	146.7	123.5	106.4	122.5	<b>112.7</b>	17.8
'40	I	104.2	141.2	57.4	108.0	160.1	141.2	116.1	135.6	<b>124.0</b>	16.3
	II	108.0	140.5	56.7	109.2	165.2	148.4	122.2	141.8	<b>128.0</b>	16.7
	III	117.3	140.5	58.6	113.5	171.1	148.6	122.2	143.4	<b>130.9</b>	17.6
	IV	127.5	140.5	58.8	117.8	173.5	151.9	119.8	144.1	<b>133.0</b>	17.9
'41	I	129.8	141.3	61.9	119.8	179.0	154.8	124.7	148.6	<b>136.4</b>	18.0
	II	137.9	142.8	65.3	124.4	181.2	161.6	137.2	156.6	<b>143.0</b>	18.0
	III	145.0	142.8	65.4	127.4	181.0	165.6	138.5	158.3	<b>145.3</b>	18.0
	IV	151.0	142.8	68.9	130.7	181.6	163.1	134.2	155.8	<b>145.2</b>	18.1

\* The averages of the four quarterly figures to each year do not necessarily coincide with the annual averages, as the latter are based as far as possible on average weekly prices. See also the *Journal*, 1893, p. 221; 1895, p. 144; 1901, p. 90; and 1909, p. 70.

† Silver, parity of 1 gold to 15½ silver = 100.



### Construction of the Tabular Statements

The following table illustrates the method of construction of the index numbers. The index numbers here given are based on the average prices for the eleven years 1867-77. Take, for instance, the *Gazette* price of English wheat :—

		s.	d.	
Average, 1867-77	... 54	6	= 100,	average point.
„ 1914	... 35	0	= 64,	or 36 per cent. <i>below</i> the average point.
„ 1930	... 80	7	= 148,	„ 48 „ <i>above</i> „ „
„ 1936	... 53	3	= 98,	„ 2 „ <i>below</i> „ „

The individual index numbers, therefore, represent simple percentages of the average point.

The articles are grouped in six categories :—

	Index Nos.	1867-77 Total Numbers	Example for 1941	
			Total Numbers	Average
1. Vegetable food, corn, etc. (wheat flour, barley, oats, maize, potatoes, and rice) ...	8	800	1,117	140
2. Animal food (beef, mutton, pork, bacon, and butter) ... ..	7	700	997	142
3. Sugar, coffee, and tea ... ..	4	400	261	65
1-3. <i>Food</i> ... ..	19	1,900	2,375	125
4. Minerals (iron, copper, tin, lead, and coal)...	7	700	1,266	181
5. Textiles (cotton, flax, hemp, jute, wool, and silk) ... ..	8	800	1,288	161
6. Sundry materials (hides, leather, tallow, oils, soda, nitrate, indigo, and timber) ...	11	1,100	1,466	133
4-6. <i>Materials</i> ... ..	26	2,600	4,020	155
<i>General Average</i> ... ..	45	4,500	6,395	142

The general average is drawn from all forty-five descriptions, which are treated as of equal value, and is the simple arithmetic mean as shown above.

## Index of Silver Prices

The base of the index numbers given below is 60.84d. per standard oz. = 100, this being a parity of 1 fine oz. of gold to 15½ standard ozs. of silver.\*

	Price per oz. standard	Index number		Price per oz. standard	Index number
Average 1873 ...	d. 59½	=97.4	Lowest Nov., 1902	d. 21½	=35.6
" '90-99...	34	=55.8	End Dec., 1906 ...	32½	=53.1
" 1917-26...	40½	=66.6	" Dec., '08 ...	23½	=38.1
" 1893 ...	35½	=58.6	" Dec., '12 ...	29	=47.7
" '96 ...	30½	=50.5	" Dec., '13 ...	26½	=43.7
" 1909 ...	23½	=38.9	" June, '14 ...	26	=42.7
" '14 ...	25½	=41.6	" Dec., '14 ...	22½	=37.3
" '15 ...	23½	=38.9	" Dec., '15 ...	26½	=43.1
" '16 ...	31½	=50.4	" Dec., '16 ...	36½	=58.7
" '17 ...	40½	=65.8	" Dec., '17 ...	43½	=70.0
" '18 ...	47½	=76.4	" Dec., '18 ...	48½	=77.9
" '19 ...	57	=85.3	" Dec., '19 ...	77½	=98.3
" '20 ...	61½	=76.1	" Dec., '20 ...	40½	=49.2
" '21 ...	36½	=48.1	" Dec., '21 ...	34½	=49.3
" '22 ...	34½	=51.6	" Dec., '22 ...	31½	=49.6
" '23 ...	31½	=49.4	" Dec., '23 ...	33½	=49.0
" '24 ...	34	=50.7	" Dec., '24 ...	31½	=50.4
" '25 ...	32½	=52.5	" Dec., '25 ...	31½	=52.1
" '26 ...	28½	=47.1	" Dec., '26 ...	25	=41.1
" '27 ...	26½	=42.8	" Dec., '27 ...	26½	=43.6
" '28 ...	26½	=44.0	" Dec., '28 ...	26½	=43.3
" '29 ...	24½	=40.2	" Dec., '29 ...	21½	=35.2
" '30 ...	17½	=29.0	" Dec., '30 ...	14½	=23.7
" '31 ...	14½	=20.4	" Dec., '31 ...	20½	=21.6
" '32 ...	17½	=19.5	" Dec., '32 ...	16½	=17.2
" '33 ...	18½	=18.7	" Dec., '33 ...	19½	=19.5
" '34 ...	21½	=20.0	" Dec., '34 ...	24½	=22.6
" '35 ...	29	=26.4	" Dec., '35 ...	22½	=20.6
" '36 ...	20½	=18.5	" Dec., '36 ...	21½	=19.4
" '37 ...	20½	=18.4	" Dec., '37 ...	19½	=17.7
" '38 ...	19½	=17.6	" Dec., '38 ...	20½	=17.3
" '39 ...	20½	=17.1	" Dec., '39 ...	22½	=17.3
" '40 ...	22½	=17.1	" Dec., '40 ...	23½	=17.9
" '41 ...	23½	=18.0	" Dec., '41 ...	23½	=18.1

\* All the index numbers in the table from 1916 to 1925 inclusive and from 1931 to date are calculated on the basis of the gold prices of silver instead of the sterling prices, though the latter are the price quotations given in the table. In arriving at the index numbers for these dates the prices of gold are taken as follows. For 1916, 1917 and 1918 the price is taken as 86s. 9½d. per fine oz., derived from the "pegged" New York rate of \$4.76½ to the £. For 1919 the average price of gold is taken as 93s. 4½d., this being the parity price with the U.S. dollar, the average New York exchange in that year being \$4.429. For the other dates the index numbers are based on the quotations in the London market for exportable gold. The quotation at the end of 1919 was 109s. 8½d. per fine oz. At the end of 1920, 1921, 1922, 1923 and 1924 the quotations per fine oz. were 116s. 1d., 98s. 0d., 88s. 11d., 95s. 4d., and 88s. 2d. respectively and the average quotations in these years were 112s. 11½d., 107s. 0½d., 93s. 4d., 90s. 3d., and 93s. 8½d. respectively, while the average price in 1925 was 85s. 5½d. The prices at the end of 1931, 1932, 1933, 1934, 1935, 1936, 1937, 1938, 1939, 1940 and 1941 were 121s. 11d., 123s. 9d., 126s. 6d., 141s. 0d., 141s. 2d., 141s. 7d., 139s. 6d., 149s. 7½d., 168s., 168s. and 168s. respectively, and the average prices in these years were 92s. 6½d., 118s. 0½d., 124s. 10½d., 137s. 7½d., 124s. 1½d., 140s. 3½d., 140s. 8½d., 142s. 6½d., 154s. 4d., 168s. and 168s. respectively.

*World's Production of Silver (in millions of ounces)*

	United States	Mexico	Canada	Australia	Other Countries	Total
1904...	57.7	60.8	3.7	14.5	27.5	164.2
'05...	56.1	65.0	5.9	15.0	30.3	172.3
'06...	56.5	55.2	8.5	14.2	30.6	165.0
'07...	56.5	61.0	12.8	19.0	34.8	184.2
'08...	52.4	73.6	22.1	17.2	37.8	203.1
'09...	54.7	73.9	27.5	16.3	39.7	212.1
'10...	57.1	71.4	32.9	21.5	38.8	221.7
'11...	60.4	79.0	32.7	16.6	37.5	226.2
'12...	63.8	74.6	31.6	18.1	36.2	224.3
'13...	66.8	70.7	31.5	3.5	51.4	223.9
'14...	72.4	27.5	28.4	3.6	36.5	168.4
'15...	74.9	39.5	28.4	4.1	37.3	184.2
'16...	74.4	38.2	25.4	4.2	26.6	168.8
'17...	71.7	35.0	22.2	10.0	35.3	174.2
'18...	67.8	62.5	21.2	10.0	35.9	197.4
'19...	56.7	62.7	15.7	7.4	32.0	174.5
'20...	55.5	66.8	12.6	7.5	33.0	175.4
'21...	53.1	64.5	13.1	4.9	35.7	171.3
'22...	56.2	81.1	18.6	11.3	46.3	213.5
'23...	73.3	90.9	17.8	13.3	50.7	246.0
'24...	65.3	91.5	19.7	10.8	52.2	239.5
'25...	66.1	92.9	20.2	11.1	54.8	245.1
'26...	62.7	98.3	22.4	11.2	59.0	253.6
'27...	60.4	104.6	22.7	9.0	57.3	254.0
'28...	58.4	108.5	21.9	9.0	59.5	257.3
'29...	61.2	108.7	23.1	9.0	59.7	261.7
'30...	51.0	105.0	26.0	8.9	57.1	248.0
'31...	31.0	86.0	21.0	7.6	50.4	196.0
'32...	24.0	69.0	18.0	6.5	47.5	165.0
'33...	22.8	68.1	15.2	11.0	52.0	169.1
'34...	32.5	74.1	16.4	10.8	56.6	190.4
'35...	45.6	75.6	16.6	11.4	71.5	220.7
'36...	63.4	77.5	18.3	12.7	81.8	253.7
'37...	71.3	84.7	22.7	14.3	80.9	273.9
'38...	61.7	81.0	22.2	103.0		267.9
'39...	57.8	75.9	24.6	100.5		258.8
'40...	67.0	82.6	25.4	98.7		273.7
'41*	70.0	79.0	23.0	96.0		268.0

\* Provisional. (Estimate by Messrs. Samuel Montagu &amp; Co.)

(000's omitted)

Year	Value of output £	Year	Value of output £
1851 ... ..	17,200	1897 ... ..	48,509
'52 ... ..	26,550	'98 ... ..	58,949
'53 ... ..	31,090	'99 ... ..	63,027
'54 ... ..	25,490	1900 ... ..	52,312
'55 ... ..	27,015	'01 ... ..	53,630
'56 ... ..	29,520	'02 ... ..	60,975
'57 ... ..	26,655	'03 ... ..	67,337
'58 ... ..	24,930	'04 ... ..	71,380
'59 ... ..	24,970	'05 ... ..	78,143
'60 ... ..	23,850	'06 ... ..	82,707
'61 ... ..	22,760	'07 ... ..	84,857
'62 ... ..	21,550	'08 ... ..	90,995
'63 ... ..	21,390	'09 ... ..	93,302
'64 ... ..	22,600	'10 ... ..	93,544
'65 ... ..	24,040	'11 ... ..	94,930
'66 ... ..	24,220	'12 ... ..	95,783
'67 ... ..	22,805	'13 ... ..	97,481
'68 ... ..	21,945	'14 ... ..	92,709
'69 ... ..	21,245	'15 ... ..	97,114
'70 ... ..	21,370	'16 ... ..	92,597
'71 ... ..	25,400	'17 ... ..	87,236
'72 ... ..	24,200	'18 ... ..	78,605
'73 ... ..	23,600	'19 ... ..	73,078
'74 ... ..	22,950	'20 ... ..	68,522
'75 ... ..	22,700	'21 ... ..	67,848
'76 ... ..	22,540	'22 ... ..	66,723
'77 ... ..	23,830	'23 ... ..	77,888
'78 ... ..	22,020	'24 ... ..	81,807
'79 ... ..	21,400	'25 ... ..	82,267
'80 ... ..	22,130	'26 ... ..	82,211
'81 ... ..	21,150	'27 ... ..	82,582
'82 ... ..	20,500	'28 ... ..	82,400
'83 ... ..	20,640	'29 ... ..	84,500
'84 ... ..	20,830	'30 ... ..	88,500
'85 ... ..	21,250	'31 ... ..	95,100
'86 ... ..	21,430	'32 ... ..	103,400
'87 ... ..	21,735	'33 ... ..	107,700
'88 ... ..	22,644	'34 ... ..	116,000
'89 ... ..	25,375	'35 ... ..	125,700
'90 ... ..	24,421	'36 ... ..	140,900
'91 ... ..	26,846	'37 ... ..	148,400 *
'92 ... ..	30,134	'38 ... ..	158,700 *
'93 ... ..	32,363	'39 ... ..	165,500 *
'94 ... ..	37,229	'40 (provisional)	173,800
'95 ... ..	40,843	'41 (provisional)	174,300
'96 ... ..	41,559		

\* Amended figures.

*Gold.*—The table shows the world's annual gold production since 1851. Prior to 1911 the estimates are those of the Bureau of the U.S. Mint and other authorities. The estimates since 1926 are those of the Union Corporation, Limited. The value is taken throughout at £4.25 per fine oz.

## Average Prices of Commodities \*

No. of Article }	0	1		2	3	4	5	6	7	8	1-8	9	10
		Wheat			Flour	Barley	Oats	Maize §	Pota- toes *	Rice	Vegetable Food	Beef †	
		English Gazette	Ameri- can	Town Made white(now "G.R.") s. per sack (280 lbs.)	English Gazette	English Gazette	Ameri- can Mixed	Good English	Rangoon Cargoes to Arrive	Prime		Mid- dling	
Year	Silver †	s. and d. per qr.	s. and d. per qr.	s. and d. per qr.	s. and d. per qr.	s. and d. per qr.	s. and d. per qr.	s. per qr.	s. per ton	s. and d. per cwt.	Total	d. per 8 lbs.	d. per 8 lbs.
1873 ...	59½	58-8	63	51	40-5	25-5	30	160	9-6	—	65	56	
1921 ...	36½	72-9	73-9	64½	54-4	34-5	38½	198	18-5	—	115	109½	
'22 ...	34½	47-10	52-11	45½	40-1	29-1	31½	130	14-10	—	88½	82	
'23 ...	31½	42-2	47-3	39½	33-8	26-8	36	101	14-10	—	79½	74½	
'24 ...	34	49-3	53-9	43½	46-9	27-2	39½	186	16-9	—	82½	76½	
'25 ...	32½	52-2	62-4	50½	42-0	27-2	38½	154	16-0	—	80	73½	
'26 ...	28½	53-3	58-9	49½	36-11	25-1	29½	127	16-3	—	74	67	
'27 ...	26½	49-3	58-3	44½	42-0	25-4	30½	136	15-11	—	70	62	
'28 ...	26½	44-8	50-10	40½	39-0	29-0	38½	133	15-0	—	74	66½	
'29 ...	24½	42-2	51-3	38½	35-5	24-7	36½	111	14-3	—	71	66	
'30 ...	17½	34-3	36-10	33½	28-3	17-2	23	93	13-0	—	73	68	
'31 ...	14½	24-0	25-1	22½	28-0	17-8	15½	146	9-8	—	67	61	
'32 ...	17½	25-0	27-5	24½	27-1	19-3	18½	152	9-8	—	65	59	
'33 ...	18½	22-10	25-7	23½	28-7	15-10	17½	86	7-9	—	61	52	
'34 ...	21½	20-2	28-0	23½	30-11	17-5	19½	97	7-8	—	58	52	
'35 ...	29	22-2	31-1	25½	28-7	18-9	17½	107	8-10	—	54	49	
'36 ...	20½	30-9	35-1	31½	29-5	17-8	19½	146	9-0	—	54	50	
'37 ...	20½	40-0	49-7	40½	39-0	23-11	26½	136	10-5	—	61	57	
'38 ...	19½	28-11	39-3	30½	36-4	21-2	28½	111	10-7	—	62	58	
'39 ...	20½	21-5	30-1	22½	31-7	19-3	26½	117	11-1	—	61	58	
'40 ...	22½	42-10	33-6	24½	64-10	37-2	39½	143	15-5	—	72	68	
'41 ...	23½	62-10	32-2	27½	85-8	40-10	43	164	23-8	—	72	68	
Average													
1904-13	26½	31½	36	30	25½	18½	24½	78	7½	—	51	44½	
1890-99	34	28½	31½	27½	25½	17½	19½	72	6½	—	47	37½	
'78-87	50	40	43½	34½	31½	21	25	102	8	—	55½	46	
'67-77	58½	54½	56	46	39	26	32½	117	10	—	59	50	

Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100

1873 ...	97-4	108	113	104	104	98	92	137	95	851	110	112
1921 ...	48-1	133	132	140	139	132	118	169	184	1,147	195	220
'22 ...	51-6	88	95	100	103	112	96	111	148	853	150	164
'23 ...	49-4	77	84	86	86	103	111	86	148	781	134	149
'24 ...	50-7	90	96	95	120	105	122	159	167	954	139	152
'25 ...	52-5	96	111	109	108	105	119	132	160	940	136	147
'26 ...	47-1	98	105	107	95	96	92	109	163	865	125	134
'27 ...	42-8	90	104	98	108	97	95	116	159	867	119	124
'28 ...	44-0	82	91	87	100	112	118	114	150	854	125	133
'29 ...	40-2	77	91	84	91	95	112	95	143	788	120	132
'30 ...	29-0	63	66	72	72	66	71	79	130	619	124	136
'31 ...	20-4	44	45	50	71	68	48	125	93	544	114	122
'32 ...	19-5	46	49	53	69	74	58	130	93	572	110	118
'33 ...	18-7	42	46	52	73	61	53	74	78	479	103	104
'34 ...	20-0	37	50	50	79	67	60	83	77	503	98	104
'35 ...	26-4	41	56	56	73	72	53	91	88	530	92	98
'36 ...	18-5	56	63	69	75	68	60	125	90	606	92	100
'37 ...	18-4	73	89	88	100	92	82	116	105	745	103	114
'38 ...	17-6	53	70	67	93	81	86	95	106	651	105	116
'39 ...	17-1	39	54	48	81	74	82	100	111	589	103	116
'40 ...	17-1	78	60	53	166	143	122	122	154	898	122	136
'41 ...	18-0	115	57	60	220	157	132	140	236	1,117	122	136

\* The annual prices are the average monthly or weekly quotations, except potatoes, which are the average weekly quotations during the eight months January to April and September to December.

† Not included in the general average.

‡ Meat (9-13), by the carcass, in the London Central Meat Market.

§ La Plata from 1934.

## Average Prices of Commodities—Contd.

No. of Article	11 12		13	14	15	9-15	16A	16B	17	18A*	18B*	18
	Mutton		Pork	Bacon	Butter		Sugar			Coffee		Mean of 18A and 18B
	Prime	Mid- dling	Large and Small, average	Water- ford	Fries- land, Fine to Finest		Animal Food  Total	British West Indian Refining    s. per cwt.	Beet, German, 88 p. c., f.o.b.  s. per cwt.	Java, Planting Cargoes  s. per cwt.	Ceylon Plan- ta- tion, Low Mid- dling † s. per cwt.	
Year	d. per 8 lbs.	d. per 8 lbs.	d. per 8 lbs.	s. per cwt.	s. per cwt.							
1873 ...	71	63	54	81	123	—	22½	25	28	100	86	—
1921 ...	130½	125½	121½	179	250	—	19½	18½†	22	120¾	63	—
'22 ...	125	121½	101	145½	202½	—	15	14½	15½	120¾	74½	—
'23 ...	114½	107½	89	113½	186	—	25½	23½	24½	117½	55	—
'24 ...	111½	103½	70	106	211	—	23½	20½	21½	152¾	85½	—
'25 ...	106½	98½	84½	128½	206½	—	16½	11½	12½	153½	98½	—
'26 ...	89	80½	98½	130	173	—	16½	11½	12½	154½	89½	—
'27 ...	86	79½	85	102½	178	—	16½	12½	13½	143½	71½	—
'28 ...	92½	87	77	101½	185½	—	13½	10½	11½	143½	81½	—
'29 ...	89½	83	91	116½	180½	—	11½	8½	8½	141½	74½	—
'30 ...	92	86	89	105½	146½	—	8½	5½	6½	106½	42½	—
'31 ...	79	73	65	83½	130	—	7½	5½	6½	101½	33½	—
'32 ...	63	55	54	77	126½	—	7½	5½	5½	105½	54½	—
'33 ...	69	63	60	81½	105½	—	7½	4½	5½	86½	42½	—
'34 ...	74	70	65	90½	79½	—	6½	4½	4½	87½	42½	—
'35 ...	75	70	62	89	92½	—	6½	3½	4½	67½	29½	—
'36 ...	73	68	65	93½	98½	—	6½	3½	4½	58½	30½	—
'37 ...	78	74	68	94	108½	—	7½	5½	6½	75½	36½	—
'38 ...	62	56	69	97½	114½	—	7½	4½	5½	75	19½	—
'39 ...	68	64	70	97½	122	—	9½	6½	7½	73½	22½	—
'40 ...	85	76	96	114½	143	—	9½	—	8½	86½	28½	—
'41 ...	85	76	96	123½	142½	—	9½	—	8½	137½	30½	—
Average	58½	51½	47½	67	113	—	10½	10½	12	75½	43½	—
1904-13	54½	41½	42½	59	100	—	11½	11½	13½	98	62	—
1890-99	64½	53	49	71	116	—	17	18	21½	78	52	—
'78-87	64½	53	49	71	116	—	17	18	21½	78	52	—
'67-77	63	55	52	74	125	—	23	24	28½	87	64	—
Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100												
1873 ...	113	114	104	109	98	760	101		98	115	134	125
1921 ...	208	228	234	242	200	1,527	81		77	140	98	119
'22 ...	199	221	194	196	162	1,286	62		54	140	116	128
'23 ...	182	196	171	154	149	1,135	104		87	135	86	111
'24 ...	177	188	135	143	169	1,103	93		75	175	133	154
'25 ...	169	180	162	174	165	1,133	60		43	176	154	165
'26 ...	141	146	190	176	138	1,050	60		44	178	139	159
'27 ...	136	145	163	138	142	967	62		47	165	112	139
'28 ...	146	158	148	137	149	996	51		40	165	127	146
'29 ...	142	151	175	157	144	1,021	42		31	162	117	140
'30 ...	146	155	171	143	117	992	31		22	123	66	95
'31 ...	125	133	125	113	104	836	29		23	120	53	87
'32 ...	100	100	104	104	101	737	27		20	121	85	103
'33 ...	110	114	115	110	84	740	25		18	100	66	83
'34 ...	117	127	125	122	64	757	22		16	100	67	84
'35 ...	119	127	119	120	74	749	21		17	78	46	62
'36 ...	116	124	131	127	79	763	21		17	67	48	58
'37 ...	124	135	125	127	86	820	28		23	87	57	72
'38 ...	98	102	133	131	92	777	24		19	86	31	59
'39 ...	108	116	135	132	98	808	32		26	85	35	60
'40 ...	135	138	185	155	114	985	42		29	99	44	72
'41 ...	135	138	185	167	114	997	42		29	158	47	102

\* Index numbers not included in general average.

† Comparative values.

† E. India good middling from 1908-. § Raw Centrifugals, 96% Pol., from 1924. || White Java C.I.F., from 1924.

## Average Prices of Commodities—Contd.

No. of Article }  Year	19A*	19C* Tea	19B*	19	16-19	1-19	20A	20B	21	22	—	23
	Congo, Com- mon	Indian, Good Medium	Average Import Price	Mean of 19A and 19B	Sugar, Coffee, and Tea  Total	Food  Total	Iron			Copper		Tin  Straits
							Scottish Pig	Cleveland (Mid- dles- brough) Pig	Bars, Com- mon	Stand- ard	English Tough Cake	
d. per lb.	d. per lb.	d. per lb.				s. and d. per ton	s. and d. per ton	per ton	per ton	per ton	per ton	
1873 ...	12	—	16.67	—	—	—	117.3	—	12½	84	92	132
1921 ...	4½	7	12.4	—	—	—	168.6	137.4	19½	69½	72½	171
'22 ...	8½	13½	14.9	—	—	—	99.10	90.7	11½	63½	66½	162
'23 ...	11	17½	17.58	—	—	—	108.0	108.9	11½	65½	69½	206
'24 ...	9½	17½	19.0	—	—	—	96.8	88.2	12½	63½	67½	251
'25 ...	7½	14½	18.34	—	—	—	83.4	72.8	11½	61½	65½	267
'26 ...	7½	16½	18.82	—	—	—	87.2	87.6	11½	58½	63½	297½
'27 ...	6½	14½	18.58	—	—	—	80.5	73.0	11½	55½	60½	303½
'28 ...	6½	12½	16.84	—	—	—	69.9	65.9	9½	63½	66½	229½
'29 ...	6½	11½	16.11	—	—	—	74.0	70.3	9½	75½	78½	207½
'30 ...	5½	9½	15.12	—	—	—	76.0	67.0	9½	54½	58½	144½
'31 ...	4½	6½	13.29	—	—	—	71.0	58.6	10½	38½	39½	121½
'32 ...	4½	5½	10.75	—	—	—	68.2	58.6	10	31½	33½	140
'33 ...	6½	8½	11.87	—	—	—	66	62.3	9½	32½	34½	202½
'34 ...	8½	12	13.20	—	—	—	69.6	66.11	9	30½	32½	232½
'35 ...	6½	10½	13.06	—	—	—	70.6	67.10	9½	32½	34½	230½
'36 ...	6½	11½	13.19	—	—	—	78.6	73.2	10½	37½	41½	207½
'37 ...	6½	13½	14.58	—	—	—	104.6	94.4	12½	54½	59½	246½
'38 ...	6½	11½	14.04	—	—	—	118.0	109	13½	41½	45½	193½
'39 ...	6½	11½	14.18	—	—	—	104.3	100.7	12½	44½	—	232½
'40 ...	—	—	15.33	—	—	—	114.10	116.4	14½	62	—	273½
'41 ...	—	—	15.13	—	—	—	123	128	15½	68	—	284½
Average 1904-13	7½	7½	8½	—	—	—	57½	51½	6½	67½	72	164½
1890-99	4½	7½	9½	—	—	—	47	41½	5½	50	53	81
'78-87	6½	—	12½	—	—	—	46	38	5½	55	60	89
'67-77	11½	—	17½	—	—	—	69	60	8½	75	81	105
Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100												
1873 ...	107	—	97	102	426	2,037	170	—	152	112	—	126
1921 ...	39	—	72	55	332	3,006	237	—	232	92	—	163
'22 ...	77	—	86	82	326	2,465	148	—	136	84	—	154
'23 ...	98	—	102	100	402	2,318	168	—	144	88	—	196
'24 ...	82	—	110	96	418	2,475	143	—	152	84	—	239
'25 ...	70	—	106	88	356	2,429	121	—	144	82	—	254
'26 ...	69	—	109	89	352	2,267	135	—	139	77	—	283
'27 ...	60	—	108	84	332	2,166	119	—	136	74	—	289
'28 ...	56	—	98	77	314	2,164	105	—	120	55	—	219
'29 ...	54	—	93	74	287	2,096	112	—	118	101	—	198
'30 ...	46	—	88	67	215	1,826	111	—	121	73	—	138
'31 ...	42	—	78	60	199	1,579	100	—	123	52	—	115
'32 ...	38	—	62	50	200	1,509	98	—	121	43	—	131
'33 ...	58	—	68	63	189	1,408	99	—	117	44	—	193
'34 ...	77	—	77	77	199	1,459	106	—	116	40	—	221
'35 ...	60	—	76	68	168	1,447	107	—	117	43	—	219
'36 ...	56	—	76	66	162	1,531	118	—	123	50	—	198
'37 ...	58	—	85	72	195	1,760	154	—	149	73	—	235
'38 ...	58	—	81	70	172	1,600	176	—	161	56	—	185
'39 ...	56	—	82	69	187	1,584	159	—	160	59	—	221
'40 ...	—	—	89	89	232	2,115	179	—	173	83	—	260
'41 ...	—	—	88	88	261	2,375	195	—	180	83	—	271

\* Index numbers not included in the general average. † Approximate. ‡ Nominal. § First 9 months only.

## Average Prices of Commodities—Contd.

No. of Article } Year	24 Lead	25A Wallsend Hetton in London §	25B New- castle Steam	26 Average Export Price	20-26 Minerals Total	27 Mid- dling Ameri- can d. per lb.	28 Fair Dhol- erah	29A Petro- grad ¶	29B Russian Average Import Price	30A Manila Fair Roping	30B Petro- grad Clean (a)	31 Good Me- dium ††
	English Pig £ per ton	s. per ton	s. per ton	s. per ton		d. per lb.	d. per lb.	£ per ton	£ per ton	£ per ton.	£ per ton	£ per ton
1873 ...	23½	32	—	20-90	—	9	6½ <sup>a</sup>	47½	44	43	36	18
1921 ...	24½	32½	29	34-83	—	9-4	5½ <sup>a</sup>	112½	118½	40½	145½	27½
'22 ...	25½	34½	24½	24-16	—	12-10	8	95	84½	33½	57½	30½
'23 ...	28½	32½ <sup>b</sup>	28	25-13	—	15-25	10	83½	84½	33½	57	26
'24 ...	35½	27½	22½ <sup>b</sup>	23-38	—	16-26	11-03	120	104½	44	81	31½
'25 ...	37½ <sup>c</sup>	29½	16½ <sup>b</sup>	20-08	—	12-64	11-01	92½	120½	46½	89½	49½ <sup>d</sup>
'26 ...	32½	**30½ <sup>d</sup>	**16½ <sup>e</sup>	18-59	—	9-40	7-75	65	72½ <sup>f</sup>	43	74½	43½
'27 ...	25½ <sup>g</sup>	23½ <sup>g</sup>	14½ <sup>g</sup>	17-80	—	9-54	8-27	95½ <sup>g</sup>	74½ <sup>g</sup>	43½	66½ <sup>g</sup>	32½
'28 ...	22½ <sup>h</sup>	21½ <sup>h</sup>	13½ <sup>h</sup>	15-67	—	10-92	8-66	98½	91½ <sup>h</sup>	37½ <sup>h</sup>	63½ <sup>h</sup>	33½ <sup>h</sup>
'29 ...	24½ <sup>i</sup>	23½	15½ <sup>i</sup>	16-13	—	10-26	7-73	76½ <sup>i</sup>	71½ <sup>i</sup>	37½ <sup>i</sup>	61	32
'30 ...	19½	24½ <sup>j</sup>	14½ <sup>j</sup>	16-64	—	7-49	5-12	53½	60½ <sup>j</sup>	26½	48½ <sup>j</sup>	20
'31 ...	14½ <sup>k</sup>	24½	13½	15-98	—	5-90	4-60	36	35½ <sup>k</sup>	18½	27½	15½ <sup>k</sup>
'32 ...	13½ <sup>l</sup>	23½ <sup>l</sup>	13½	16-27	—	5-24	4-85	45½ <sup>l</sup>	42½ <sup>l</sup>	18½ <sup>l</sup>	36	16½ <sup>l</sup>
'33 ...	13½	22½	13½ <sup>m</sup>	16-08	—	5-54	4-53	51½ <sup>m</sup>	48½ <sup>m</sup>	15½	37	14½
'34 ...	12½	20½	14½ <sup>n</sup>	16-08	—	6-70	4-80	60½ <sup>n</sup>	50½ <sup>n</sup>	14½ <sup>n</sup>	42½ <sup>n</sup>	14½ <sup>n</sup>
'35 ...	16	20½ <sup>o</sup>	14½ <sup>o</sup>	16-30	—	6-71	5-42	79½	72½ <sup>o</sup>	19½ <sup>o</sup>	43½	16½ <sup>o</sup>
'36 ...	19½ <sup>p</sup>	23½ <sup>p</sup>	15½ <sup>p</sup>	16-98	—	6-71	5-12	63½ <sup>p</sup>	60½ <sup>p</sup>	28½ <sup>p</sup>	42½ <sup>p</sup>	17½ <sup>p</sup>
'37 ...	24½ <sup>q</sup>	24½	20½ <sup>q</sup>	19-05	—	6-21	4-80	78½ <sup>q</sup>	70½ <sup>q</sup>	34½ <sup>q</sup>	38½ <sup>q</sup>	19½ <sup>q</sup>
'38 ...	17½ <sup>r</sup>	25½ <sup>r</sup>	18½ <sup>r</sup>	21-32	—	4-93	3-67	66½ <sup>r</sup>	63½ <sup>r</sup>	21½ <sup>r</sup>	38½ <sup>r</sup>	17½ <sup>r</sup>
'39 ...	17½	25½ <sup>s</sup>	—	21-12	—	5-95	4-41	90½ <sup>s</sup>	72½ <sup>s</sup>	22½ <sup>s</sup>	48½ <sup>s</sup>	26½ <sup>s</sup>
'40 ...	26½	28½ <sup>t</sup>	—	27-23	—	8-10	6-26	177½ <sup>t</sup>	183½ <sup>t</sup>	26½ <sup>t</sup>	100½ <sup>t</sup>	27½ <sup>t</sup>
'41 ...	26½	30½ <sup>u</sup>	—	32-22	—	9-14	7-65	200½ <sup>u</sup>	—	31½ <sup>u</sup>	126½ <sup>u</sup>	26½ <sup>u</sup>
Average 1904-13	15½	18½	11½	11½	—	6½	5	32½	36½	30½	31½	18½
1890-99	12	17½	10½	10½	—	4½	3	27	27	26½	25	12½
'78-87	14	16½	8½	9	—	6	4½	33	34	35½	26½	15
'67-77	20½	22	12½	12½	—	9	6½	46	48	43	35	19

Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100

1873 ...	117	145	—	167	989	100	92	97	101	95
1921 ...	118	147	—	279	1,268	104	86	246	237	145
'22 ...	123	156	—	193	994	134	118	191	116	162
'23 ...	139	147	—	201	1,083	169	148	179	116	137
'24 ...	175	125	—	187	1,105	181	163	239	160	167
'25 ...	183	135	—	161	1,080	140	163	227	174	261
'26 ...	157	138	—	149	1,078	104	115	147	151	231
'27 ...	125	105	—	142	990	106	123	181	141	172
'28 ...	109	97	—	125	860	121	128	203	130	178
'29 ...	117	106	—	129	881	114	114	157	126	168
'30 ...	95	113	—	133	784	83	76	121	96	105
'31 ...	71	112	—	127	700	66	68	76	58	84
'32 ...	65	106	—	130	694	58	72	93	70	85
'33 ...	65	103	—	129	750	62	67	106	68	78
'34 ...	61	92	—	129	765	74	71	119	73	74
'35 ...	78	92	—	130	786	74	80	161	80	89
'36 ...	95	105	—	136	825	74	76	133	91	93
'37 ...	121	111	—	152	995	69	71	158	93	104
'38 ...	83	117	—	171	949	55	54	139	77	93
'39 ...	85	115	—	169	958	66	65	174	91	140
'40 ...	129	127	—	218	1,169	90	93	383	163	146
'41 ...	129	141	—	258	1,266	101	113	416	202	139

\* Approximate prices.

† Approximate.

‡ Nominal.

§ Best Yorkshire house after 1916.

¶ Now No. 1 Oomra, Fine.

|| Livonian Z.K. from 1921.

\*\* Average price January-April, 1926.

†† Lightnings from 1931.

(a) Russian Sirots Group 1, Sort 1 from 1931-33; Jugo-Slav Peasant from 1934.



## Average Prices of Commodities—Contd.

No. of Article }	Year	32A	32B	33	34	27-34	35A	35B	35C	36A	36B	37
		Wool			Silk	Textiles Total	Hides			Leather		Tallow
		Merino, Port Phillip, Average Fleece d. * per lb.	Merino, Adelaide, Average Greasy d. per lb.	English, Lincoln Half Hogs d. per lb.	Tsatlee † s. per lb.		River Plate, Dry d. per lb.	River Plate, Salted d. per lb.	Average Import Price d. per lb.	Dressing Hides d. per lb.	Average Import Price d. per lb.	Town s. per cwt.
1873 ...		25	11½	24½	21½	—	11	8½	—	18½	—	44
1921 ...		31½	11½	8½	26½	—	9½	8½	9·58	25½	46½	36½
'22 ...		39	17½	9½	28½	—	9½	8½	8·06	24½	36	34½
'23 ...		43½	20½	12	24½	—	9½	8½	8·23	23½	31½	36½
'24 ...		53½	25½	18½	23½	—	10½	8½	8·63	22½	33½	42½
'25 ...		41½	17½	17½	18½	—	11½	8½	9·87	22	33	42½
'26 ...		36½	16½	15	15½	—	10½	8	9·32	21½	35½	38½
'27 ...		38½	17½	15½	15½	—	12½	10½	9·85	22½	36½	33½
'28 ...		37	17½	17½	14	—	15½	11½	12·09	23½	37½	36½
'29 ...		35½	13½	16½	13½	—	10½	8½	10·80	19½	38½	36½
'30 ...		18½	8½	10½	10½	—	6½	6½	7·80	18½	33½	28½
'31 ...		14·7	7·1	8½	8½	—	5½	5½	6·12	17½	32½	19½
'32 ...		15·0	7·2	5½	8½	—	4½	4½	5·47	17½	28½	21½
'33 ...		19·9	9·3	5½	6½	—	5½	4½	5·65	17½	26½	19½
'34 ...		21½	10·4	7	5½	—	4½	4½	5·71	17½	25½	17½
'35 ...		20·1	9·5	7½	5½	—	5½	5½	5·51	17½	25½	24½
'36 ...		24·7	12·2	10½	5½	—	6½	6	6·47	17½	27½	23½
'37 ...		26·9	12·7	16·9	8½	—	8½	7½	8·62	18½	28½	23½
'38 ...		18·6	8·9	11·9	7½	—	6½	5½	6·35	14½	24½	17½
'39 ...		17·9	9·0	12·2	13½	—	6½	6½	6·39	18½	23½	16½
'40 ...		27·7	13·2	18·6	17½	—	8	8½	8·50	25½	23½	22½
'41 ...		30·8	14·3	20·5	15½	—	7½	8½	8·45	24½	24½	22½
Average												
1904-13		17½	9	10½	11½	—	9½	7½	6½	16	17	31½
1890-99		13½	6½	10	11½	—	6½	5½	5	13½	13½	25
'78-87		18½	8½	11½	15	—	8½	6½	6½	15	17	35½
'67-77		21½	9½	19½	23	—	9	7	6½	16	18½	45

Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100

1873 ...	118	—	124	95	822	120	—	—	114	—	97
1921 ...	140		44	115	1,117	123			205		81
'22 ...	180		49	125	1,075	114			174		77
'23 ...	206		61	105	1,121	113			158		81
'24 ...	254		96	102	1,362	119			163		94
'25 ...	188		87	-79	1,319	132			161		94
'26 ...	170		76	69	1,063	121			164		85
'27 ...	177		78	67	1,045	142			172		75
'28 ...	174		91	61	1,086	172			176		82
'29 ...	156		81	60	976	129			166		81
'30 ...	86		54	48	669	92			150		64
'31 ...	70		43	39	504	77			146		43
'32 ...	71		29	35	513	66			132		47
'33 ...	94		30	29	534	68			127		44
'34 ...	102		35	24	572	67			123		39
'35 ...	96		37	24	641	69			125		55
'36 ...	119		53	25	646	82			129		52
'37 ...	127		86	37	745	109			134		52
'38 ...	88		60	35	601	81			110		39
'39 ...	86		62	57	741	84			119		36
'40 ...	131		94	76	1,176	109			141		49
'41 ...	145		104	68	1,288	107			135		50

\* Port Phillip fleece washed nominal since 1896, exactly in proportion with the value of clean wool.

† Common New Style from 1921 to 1926. China, Extra "A" from 1937.

## Average Prices of Commodities—Contd.

No. of Article }	38	39	40A	40B	41	42	43	44	45A	45B	35-45	20-45	1-45
	Oil			Seeds	Petro- leum *	Soda	Nitrate of Soda	Indigo	Timber		Sundry Materials	Materials	Grand Total
	Palm	Olive	Lin- seed	Lin- seed	Re- fined	Crystals		Bengal, Good Con- suming	Hewn, Average Import Price.	Sawn or Split, Average Import Price	Total	Total	
Year	£ per ton	£ per ton	£ per ton	s. per qr.	d. per gall.	s. per ton	s. per cwt.	s. per lb.	s. per load	s. per load			
1873 ...	38	43	32	62	15½	100	15½	6½	65	62	—	—	—
1921 ...	36½	80½	31½	72½	22½	140	18½	11½	68½	156½	—	—	—
'22 ...	34½	75½	39½	75½	15½	123	14½	9½	46½	117½	—	—	—
'23 ...	36½	66½	42½	77½	13	103	13½	7½	48	131½	—	—	—
'24 ...	40½	79½	42½	81½	13½	101½	13½	6½	49½	122	—	—	—
'25 ...	40½	73½	43½	80½	13	100	13½	5½	47½	122½	—	—	—
'26 ...	37½	79½	32½	63½	13	100	13½	5½	48½	107	—	—	—
'27 ...	34½	102½	31½	64½	13	100	12½	5½	45½	107½	—	—	—
'28 ...	35½	80½	29½	66½	11½	100	10½	5½	45½	111½	—	—	—
'29 ...	34½	72½	35½	74½	12½	100	10½	5½	44½	107½	—	—	—
'30 ...	25½	52½	36½	61½	12½	100	9½	5½	44½	102½	—	—	—
'31 ...	19½	53½	18½	38½	11½	100	9½	5½	37½	83½	—	—	—
'32 ...	17½	57½	17	38½	10½	100	8½	5½	35½	75½	—	—	—
'33 ...	15½	53½	20½	39½	10½	100	8½	5½	31½	75½	—	—	—
'34 ...	13½	62½	21½	42½	10½	100	7½	5½	31½	79½	—	—	—
'35 ...	19½	61½	24½	43½	10½	100	7½	5½	32½	73½	—	—	—
'36 ...	19½	70½	28½	48½	10½	100	7½	5½	37½	78½	—	—	—
'37 ...	22½	95½	31½	54½	10½	100	7½	5½	58½	103½	—	—	—
'38 ...	14½	68½	26½	46½	10½	100	8	5½	61½	94½	—	—	—
'39 ...	14½	73½	29½	49½	11½	100	8½	5½	57½	107½	—	—	—
'40 ...	19	114½	44½	66½	14½	100	9½	5½	106½	169½	—	—	—
'41 ...	20½	118	41½	70½	15½	100	13½	5½	191½	214½	—	—	—
Average 1904-13	31½	43½	26½	49½	6½	60	10½	3	38	56	—	—	—
1890-99	24½	35	19½	38	5½	53	8½	4½	40	45	—	—	—
'78-87	32½	40	23	46	6½	62	12½	6	47	47	—	—	—
'67-77	39	50	30	60	12½*	92	14	7½	60	54	—	—	—
Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100													
1873 ...	97	86	258	122	109	110	92	111	1,163	2,974	5,011		
1921 ...	95	160	116	177	152	135	158	198	1,600	3,985	6,991		
'22 ...	89	151	127	122	134	102	128	143	1,361	3,430	5,895		
'22 ...	93	133	134	104	112	96	103	157	1,284	3,488	5,806		
'24 ...	103	160	138	105	111	97	84	151	1,325	3,792	6,267		
'25 ...	104	147	137	105	109	96	79	150	1,314	3,713	6,142		
'26 ...	96	159	106	104	109	95	78	137	1,254	3,395	5,662		
'27 ...	88	205	107	104	109	90	76	134	1,302	3,337	5,503		
'28 ...	92	161	108	94	109	78	76	138	1,286	3,232	5,396		
'29 ...	89	144	122	102	109	73	76	134	1,225	3,082	5,178		
'30 ...	65	104	110	102	109	70	76	129	1,071	2,524	4,350		
'31 ...	51	108	63	90	109	65	76	106	934	2,138	3,717		
'32 ...	45	114	61	84	109	62	76	97	893	2,100	3,609		
'33 ...	40	108	67	82	109	60	76	94	875	2,159	3,567		
'34 ...	35	124	71	80	109	56	76	97	877	2,214	3,673		
'35 ...	50	123	75	84	109	54	76	92	912	2,339	3,786		
'36 ...	51	140	85	81	109	54	79	102	964	2,453	3,984		
'37 ...	58	192	95	86	109	56	79	142	1,112	2,852	4,612		
'38 ...	38	137	81	87	109	57	79	136	954	2,504	4,104		
'39 ...	37	148	88	88	109	58	79	145	991	2,690	4,274		
'40 ...	49	228	122	117	109	70	79	243	1,316	3,661	5,776		
'41 ...	53	236	124	124	109	93	79	356	1,466	4,020	6,395		

\* Petroleum average, 1878-77.

† Nominal.

## REVIEWS OF STATISTICAL AND ECONOMIC BOOKS

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1.—*The International Gold Standard Re-Interpreted*. 1914–1934. By William Adams Brown, jun. National Bureau of Economic Research : New York. 1940. 9½" × 6½". xxx + 1,342 pp. 2 vols. \$12.

There is a great temptation in war-time to dismiss books of this nature as having a purely academic interest and to ask what is to be gained from going back in detail over the experiences of the last twenty-five years. The answer is at once simple and difficult. Simple, because we know that the war arose largely out of the failure of nations to live together economically after 1919 and because the mistakes of that period may give us the key to greater success in the future. Difficult, because the unparalleled rate at which our material wealth is being destroyed and our resources turned to unproductive use will inevitably bring problems of unprecedented magnitude which it may be easier to approach with minds freed from the prejudices of earlier experience.

Nobody can deny that the financial history of the world in the two decades 1914–1934 was both exciting and instructive. As the author says, "it was . . . the story of the straining and buckling . . . of a great human institution under the pressure of human passions, human greed and also human fortitude and will." Equally true is that the history of this period contains all the lessons which, if learnt, would provide the basis of a more stable and lasting world financial structure for the future. The main lesson is that the financial system, in its widest context, is a most sensitive indicator of the working of the more fundamental economic, social, and political forces. In other words, a stable financial system is not to be found by establishing and adhering to a "standard." Slavish adherence to "the rules of the gold standard game" would have done nothing to maintain exchange stability in a world of political upheaval or a world in which the recognition of the right of labour to economic security necessarily meant the sacrifice of external stability. "In an environment of wars and rumours of wars all long range currency policies are a delusion . . . and all that is left is a collection of expedients" (page 1,341).

It must be admitted that the title of these volumes is a misnomer. "Re-interpreted" necessarily implies that the author is offering a new approach to his material. In fact, there is nothing new in these 1,342 pages, and the interpretation given by the author of the gold standard over 1914–34 will find ready acceptance in most quarters. What Mr. Brown has done, with the acknowledged assistance of his colleagues, is to bring together into one work a most excellent and detailed critical historical account of international financial relationships over the twenty years 1914–34.

The author explains that in 1934, under the auspices of the Rockefeller Foundation and Brown University, he co-operated in a "comprehensive attempt to achieve a fresh interpretation of the international gold standard in the light of its history." The main questions which it was sought to answer were not whether the gold standard *facts* of the post-1918 world were in accordance with

the *theory* of the functioning of the gold standard before 1914, but what was the *practice* of the functioning of the gold standard in the periods in question. The fundamental hypothesis to be tested was that the successful operation of the gold standard before 1914 was due to London's central clearing position in world finance and the acceptance by London of the responsibilities inherent in that central position. Mr. Brown has no difficulty in proving his hypothesis. Before 1914, London had not only the resources necessary to operate an international financial system, but accepted the consequent responsibility. After the 1914-18 war London retained the acknowledgment of responsibility, but had lost the resources necessary for the purpose. New York and Paris, on the other hand, had the resources, but refused, deliberately or through ignorance, to accept the responsibility. It may be fairly doubted whether even the acceptance by the two new international centres of their responsibilities would have appreciably altered the history of the years 1919-34, because the fundamental thought of the period was so mistaken over the entire field of international relationships. Nevertheless, the conflict between international responsibilities and internal expediency is one which will have to be approached in the future in a far different spirit from that adopted by the American and French authorities in the financial and monetary sphere in the "between-wars" period.

The plan of the book is admirable, and students of particular subjects or periods, such as the behaviour of exchange rates during the 1914-18 war, or of the stabilization period 1919-25, will have little difficulty in finding what is of interest to them without covering all the 1,342 very full pages of material. The author divides the period into four sections—Book One, covering 1914-18, is called the period of "breakdown"; Book Two deals with 1919-25, the period of "restoration"; Book Three, 1925-31, is entitled "experimentation", and Book Four, "disintegration," carries the story to 1934.

Book One describes the behaviour of exchange rates during the 1914-18 war, and the attempts to maintain the form of the gold standard during the war period without sufficient regard to the fundamental economic changes which were taking place. It was during this period that some of the seeds of the subsequent collapse were sown, and the substance of the gold standard was sacrificed to its form. These seeds produced a screen which hid from the world the failure of a settled institution to adjust itself to an entirely new environment. The screen became more elaborate during the restoration period 1919-25, and was completed in 1928 with the stabilization of the French franc. The author gives an illuminating account of the efforts of Britain to return to the pre-1914 parity with gold, as well as useful summaries of the stabilization of the German, Belgian, Italian, and French currencies. The special attention paid to the problems of Russia, Argentina, and Japan in pages 402-22 is particularly welcome, since there is a tendency to think of the period 1919-32 solely in terms of the pound, dollar, franc, and mark.

In Book Three, Mr. Brown shows how the years 1925-31 were not only a period of experiment, but a period of illusion. What had been the strength of gold as the standard in the years up to 1914 became its weakness in the later period. "The fact that the world returned to the gold standard without being fully aware of the strength of the cyclical forces at work, of the depth of the economic maladjustments, and of the meaning of the loss of centralized control and the new imperfections of international clearing, gave to the confidence that the return inspired (*i.e.*, of sterling to the gold standard) an element of tragic illusion. . . . It was a false signpost that made dangerous ways seem safe" (page 389). That illusion was not shattered until Britain left the gold standard in September 1931, although events in the primary producing countries—especially the Southern Dominions—had been showing for some time that the disturbing developments behind the screen could no longer be hidden.

The period of "disintegration" which followed the fateful decision of the autumn of 1931 and began the release of the world from the stranglehold of deflation is carried by the author up to the devaluation of the American dollar early in 1934. In fact, the period ended only with the devaluation of the "gold

bloc" currencies a considerable time thereafter. Again we see the futile attempts of the financial authorities in Europe and the United States to maintain the form of the gold standard in the face of clearly overwhelming odds, with a resultant loss of public confidence within each country and certain profits to the speculators in foreign exchanges. In this period gold became nothing more than a purely political expression, particularly among the "gold bloc" countries, and there was a blank refusal to implement what was accepted policy. It is interesting to note that throughout the years of disintegration, Governments never failed to express their faith in an international gold standard, even at the time of devaluation, and up to the outbreak of war, we find implicitly "the common view that gold was the only acceptable international standard and that the restoration of an international monetary system meant some form of stabilization of natural currencies in terms of gold" (page 1,313). As the author rightly points out, the accepted principle that parity with gold was the only true indication of a safe and stable currency threatened at one time to lead to ludicrous consequences. In 1939 this principle would have left the German mark as the only stable currency! The question of whether gold was to be servant or master was approached with surprising diffidence to the very end.

But what of the future? Mr. Brown has little specific to offer, except the obvious fact that the maintenance of international exchange stability will be facilitated by policies of internal price stability in the countries concerned. Instead, he exposes clearly the reasons for the breakdown of the old system and leaves us to draw our own conclusions as to the future. The main conclusion which seems to emerge is that it would be a grave mistake either to assume that the problem of an international exchange standard is a simple one, or to think that it can be dealt with in isolation from the whole problem of international relationships. Grandiose schemes for international clearing systems will do little to solve the problem. What has to be realized is that in the future, as in the past, the countries of the world will neither be in the same stage of economic development nor progressing at the same rate. Accordingly, the need to make adjustments—and possibly frequent adjustments—in relative exchange rates will remain with us. It can hardly be expected that any country will be prepared to yield the sovereign right to depreciate the external value of its currency in order to mitigate the social consequences of its economic policy. The best we can hope for is probably an agreement that alterations in the value of national currencies will only be made after consultation, and certainly not, as in the past, in an atmosphere of crisis and expediency. For such an agreement a substantial *quid pro quo* will be necessary to those nations to whom currency devaluation has been a major source of relief in the past—e.g., primary producers, such as the Southern Dominions or the South American republics, and "middle-aged" industrial countries, such as the United Kingdom. It is to be hoped that the *quid pro quo* will be a courageous international effort to deal with the economic problem of the post-1918 world.

Unfortunately, it may be doubted whether a dispassionate approach to the question of the relation of gold to the international exchange standard will be made. Both the British Commonwealth and the United States have large vested interests in the continued supremacy of gold—the one as the largest producer, the other as the holder of the bulk of the world's stocks. In this connection it is perhaps significant that, despite the grave shortage of skilled manpower and essential materials among the United Nations, the process of digging gold from the depths of the Rand for ultimate re-burial in the wilds of Kentucky has not been hindered. However, with the substantial appreciation in the value of gold in recent years, we shall at least be spared the 1930-32 bogey of a gold shortage.

J. E. W.

2.—*Fluctuations in Income and Employment*. By T. Wilson. Pitman, 1942. 8½" × 5½". 213 pp. 18s.

This book contains, first, a summary of recent discussions on the theory of the trade cycle and, secondly, a brief review of American experience in the years

1919-37. The work does not claim to be particularly original and is open to a number of criticisms; but it provides an ably written summary, which should be useful to the general student, if he can afford the price.

The discussion in the first part is conducted throughout in terms of the inequality between savings and investment *ex ante*. The meaning of these terms is never clearly defined, and, although the author seems to be aware of the many obscurities in this terminology, he only poses the question, "What is the significance of . . . psychic plans in the minds of savers and investors?" (page 37), without providing any answer. As a result, the argument is often confused, and leads to a number of questionable conclusions. It is clearly absurd, for example, to say that, when incomes are expanding, *ex ante* consumption will exceed *ex post* consumption (p. 115 n.). Mr. Lerner is rebuked (p. 7-8) for arguing that an increased propensity to save will not produce an increase in total savings or the demand for securities, because incomes will be reduced. The author appears to assume that a rise in *ex ante* savings (whatever this is intended to mean) will lead to an increased demand for securities, which may cause the rate of interest to fall, but this is simply begging the question. It is also unreasonable to argue (p. 11) that savings can increase if the supply of securities remains unchanged. One recalls Lord Keynes's remark that "If there is no change in the liquidity position, the public can save *ex-ante* and *ex-post* and *ex-anything-else* until they are blue in the face, without alleviating the position in the least" (*Economic Journal*, 1937, p. 668). Professor Robertson's period analysis does not assist the problem either, because, on each day, savings must be equal to investment. The *ex ante* method of analysis, unless handled with care, and unless the terms are precisely defined, generally seems to produce only greater confusion.

Professor Hayck's theory of capital intensity comes in for some cogent criticism, and the assumptions underlying the theory are shown to be quite unrealistic (Chapter VI). This is, perhaps, the best and most original section of the book. When, on the other hand, he tries to develop his own theory of the trade cycle, Mr. Wilson is not very sure of his ground (Chapter X). His model appears to be mainly based on the acceleration principle, which is sometimes confused with the multiplier, and which, he claims, "is the only explanation of the cumulative downswing" (pp. 45, 86). It is admitted, however (p. 45), that this principle, as Mr. Harrod has said, "rather over-explains the facts," and it is not explained why the principle is unsymmetrical; why, that is to say, it applies to the downswing and not to the upswing.

"The expansion (he says) may come to an end before a state which roughly corresponds to full employment has been reached, because . . . the rate of growth of consumption has declined"; or the end may come with inflation (pp. 84-5). But there is no necessity that either of these possibilities must occur, and the latter is clearly unrealistic as a general explanation of the upper turning-point; thus his claim that "this model is self-generating" (p. 87) can hardly be substantiated. The author realizes that there are various possibilities, and so we find that over-saving, under-consumption, the relation and the multiplier, changes in capital equipment, as well as banking policy and technical progress, all play their part at different stages. The result, it must be said, looks more like a philosophy of eclecticism than a model of the trade cycle.

The second part contains a general survey of recent developments in the U.S.A., and the various possible explanations of the course of events are each considered in turn. The method is somewhat uninspired and, as might be expected, does not really go to the roots of the problem. The author remarks, indeed, that "the severity of the downswing is closely correlated with the prosperity of the upswing" (p. 190); but, in general, he pays little attention to the effects of changes in capital equipment. The summary is useful, however, in so far as it disposes of some of the less probable explanations and clears the ground for further study.

The material in this section is competently handled, and the treatment shows that the author has considerable common sense (not too common amongst economists), with only occasional lapses here and there. The curious statement

occurs that "if the multiplier could be abolished when approximately full employment had been reached, the problem of cyclical fluctuations in income would be solved" (p. 193). But how is it possible to "abolish" the proportion of marginal income which is saved?

The concluding chapter, containing *obiter dicta* on a social philosophy, is very weak. The linking together of fascism and communism (p. 193, 200) is a little *démodé*; and not nearly sufficient attention is paid to the social and political implications of large-scale government intervention in industry. J. L. N.

3.—*Three Aspects of Labour Dynamics*. By W. S. Woytinsky. Washington: Committee on Social Security, Social Science Research Council. 1942. 9" × 6". xiv + 249 pp. \$2.50.

Although the title and certain sections of this book suggest large concentrations of mathematics and dynamics, it is in fact mainly a descriptive study. It is based entirely on American data, and deals with fluctuations in employment and the changing composition of the unemployed. It reveals the complicated ebbs and flows of workers into, through, and out of the labour market which determine variations in employment and unemployment. The book falls into three parts. The first describes the turnover of labour, the second the turnover of the unemployed, and the third the extent to which additional workers are drawn into the labour market in the various phases of the business cycle.

Labour turnover is analysed for the World War, for the 1920's, and for the period following the depression of the 1930's. It is shown that, during the World War, the shortage of labour led to heavy turnover of workers, "separations" being mainly at the instance of the workers themselves. The existence of an "unstable" group of workers is shown to have accounted for 75 per cent. of the labour turnover, and much of the great flexibility of the labour market, in those years. In the 1920's the turnover of labour dropped considerably, largely as a result of the increasing fear of unemployment and the resulting reduction in the number of "unstable" workers. After the depression of the 1930's the source of instability of employment was the varying demand for labour by industry and 75 per cent. of the terminations of employment originated from the employers' side.

The turnover of unemployed workers is examined in great detail. The duration of unemployment is measured. It is seen to have been greater in the 1930's than in the 1920's, and this gave rise to unemployment of the chronic type we knew so well. A study is made of the "hard core" of unemployment, and an ingenious statistical method invented to deduce the size of the hard core from available data. It is shown how the proportion of persons unemployed for more than one year increases as depression deepens, and then decreases under the impact of recovery.

Perhaps the most elegant statistical methods of analysis are to be found in the third part of the book. Making skilful use of the theory of probability, and the utmost ingenuity in exploiting the available data, estimates are made of the extent to which additional workers are drawn into the search for employment when the normal family wage-earner loses his job. This is by no means an easy task, and both the methods and the results of this analysis will repay serious study by all statisticians working on labour problems. It is found that there was about one additional worker per 5-6 normal workers in 1915, one per 4-5 in 1931-33, and one per 6-7 in the late 1930's.

The statistical data assembled in the course of these studies are carefully defined and, to assist future researchers, collected in appendix tables at the end of the book. The statistical analysis is lucid, and a sound balance is maintained between purely descriptive statistics and deductive logic. Wherever possible the analysis is made by industries and areas, thus enhancing the usefulness of the book as a source of reference.

The only possible criticisms of the study are in the applications of the theory of probability. It is sometimes doubtful how far the underlying assumptions are in fact warranted. For example; it is implicitly assumed that the rate of

unemployment among families with one normal wage-earner is the same whether or not an additional worker is seeking employment. In fact, of course, one would expect that the additional workers are drawn mainly from those families with the highest rates of unemployment. Similarly it is assumed that the proportion of additional workers is the same in families with one, two, three, or even four normal wage-earners. One would expect that there would be a strong inverse correlation between the proportion of additional workers and the number of normal wage-earners in the family. Nevertheless, most of these less warrantable assumptions are made from necessity owing to the limitations of the material available. In all his problems the author takes care to allow for as many of the known elements of variation as possible.

The writer is to be congratulated on the success of his well-directed and painstaking study. His valuable statistics will prove a boon to all students of labour-market problems. The suggestive methods of analysis will be stimulating to all economists and sociologists working in this field, and the results will provide a sound basis for further research.

H. W. R.

4.—*Consumer Instalment Credit and Economic Fluctuations*. By Gottfried Haberler. National Bureau of Economic Research, New York. 1942. 9" × 6". xix + 239 pp. \$2.50.

This volume is the ninth in a series of eleven studies in consumer instalment-financing. With the exclusion of real-estate mortgage credit, the scope of the subject is confined to credit obtained under what we should call hire and instalment purchase schemes, together with certain kinds of cash loans obtained for consumption purposes.

The system of consumer credit is largely a product of our own generation. The particular aspect studied by Dr. Haberler is its relationship with the cyclical fluctuations. After a brief discussion of its institutional background in the United States, he estimates that between 70 per cent. and 80 per cent. of the credit is used for the purchase of durable consumption goods. Cyclical shifts in the demand for such credit correspond closely with general business cycles, and are mainly attributed to changes in income. Statistical evidence shows that the supply of this type of credit can generally be regarded as elastic, so that it does not affect the borrowing and spending capacity of entrepreneurs. In consequence, consumer credit can be regarded as tending to amplify the fluctuations set up by other forces. When incomes rise, the demand for purchases on credit also rises. The increase in effective demand will cause producers to expand output and, ultimately, capacity for output. This procedure will again increase incomes and credit purchases, still further stimulating industry and reacting on incomes. On the other hand, a contraction of credit purchases due to a reduction in incomes would naturally have a depressing effect on industry, and this would react on incomes and demand.

The question which naturally arises at this point is whether control of consumer credit would lead to economic stability. Stimulating and depressing forces respectively applied at the right times would clearly tend to dampen the oscillations of the business cycle, but the final answer depends on two other factors: firstly the possibility of controlling consumer credit effectively, and secondly, its quantitative significance in relation to demand as a whole.

Consumer credit has been the subject of a certain amount of control in several States, but the object of the control has always been the protection of the consumer. No doubt some experience has thus been gained which will be useful when control is attempted for another purpose, but many difficulties will have to be overcome. It is clearly shown that variation in the interest rate charged on outstanding debts is useless as a regulative device. Few hire-purchasers realize the effective rate which they are paying for their credit accommodation, and in any case, on short and medium term loans, the amount of interest is rarely large enough to have a significant influence on the consumers' conduct. It is, however, possible to control demand by means of varying the "down-payment" percentage, and the period over which the balance has to be paid. A stiffening



in these terms can be relied upon to render some stratum of demand ineffective, but whether the granting of more generous terms—at a time when incomes are falling and the economic future of the worker seems uncertain—will stimulate demand is another question. At any rate, the Government of the United States has decided to use control of consumer credit in an endeavour to secure certain immediate and future objectives—namely, to conserve materials, man-power and equipment which are needed for defence purposes; to check inflation by restraining the effects of rising consumer purchasing power; and to secure a deferment of consumer demand to the post-war period to avoid any slump during the process of readjustment to normal economy. Details of the measures taken by the Executive are given in an appendix.

As to the quantitative significance of consumer credit, the book is not very definite. It is suggested, however, that even if it is negligible, effective control would be an influence in the right direction, and that concerted action in many fields should have a noticeable stabilizing effect.

The author draws attention to one difficulty inherent in the study—namely, the scarcity of statistical data. Consumer credit only became a noticeable feature of everyday life in the 1920's, while many of Dr. Haberler's series only relate to the period 1930–40, an interval which is much too brief for the statistical study of cyclical phenomena. Nevertheless, the book is particularly timely in appearance, and should be read by those concerned with planning for the war or post-war economy.

T. M. R.

5.—*Retail Trade Associations*. By Hermann Levy. Kegan Paul, Trench, Trubner & Co., Ltd., London. 1942. 5½" × 9". x + 265 pp. 15s.

This revelation of the extensive ramifications of retail trade associations with the unconcealed aim of restricting competition may come as a shock to many who have hitherto regarded the retail trade as being the last stronghold of free competition. Certainly it is difficult to understand the movement towards combination in the distributive trades, in view of the great multiplicity of the units concerned; but Professor Levy rightly points out that in this instance the number of units alone is not the significant factor. If an appreciable part of the total turnover in any trade is handled by a small number of large-scale units, monopolistic organisation is an ever-present possibility. The managements of departmental stores and multiple shops, for example, are likely to pay considerable attention to matters of general policy, and by organizing the smaller units in their trades, or by entering existing organizations, they may obtain sufficient power to achieve their ends. In other branches of distribution, the growth in the amount of capital required per business unit tends to concentrate the trade into fewer hands, leading to a consequent decline in competition.

However strong the manufacturers may be, individually or in combination, the author points out that the retailer is usually free to choose whose goods he will stock. This fact has led the manufacturers to attempt to capture the retailers' customers by branding and advertising their goods. Branding has actually proved a more powerful weapon than patent rights in securing monopoly powers for the manufacturer, while advertising has led to the mass distribution of standardized manufacturers' goods. The latter are ready weighed and packed, and carry the manufacturers' guarantees of quality rather than the retailers'. The retailer is compelled by demand to stock them, but since their distribution involves so little labour, responsibility or risk, he loses much of his individuality as a business man, and becomes in many respects little more than an agent. It is to be noted that this narrowing of the retailer's function is one of the circumstances favouring larger-scale distribution in the more thickly populated areas, and that this, in turn, favours monopolistic or quasi-monopolistic organization in the retail trade. The main point, however, is that the manufacturer is often in a position to fix not only the buying price, but also the selling price of the retailer, thereby protecting the market which he has built up for his own brand.

The retailers themselves do not favour competitive price-cutting, and their

associations are largely concerned with maintaining fixed prices for commodities. Strong associations can do something to compel the manufacturers to give better margins, but even then they must take into account the fact that generous terms may attract an undesirable flow of new entrants into distribution, and consequently their chief efforts have been directed towards price maintenance. The author discusses in detail the implications of this objective. Whereas competition weeds out inefficient firms, it is doubtful whether a system planned by the trade itself will do so. In view of the variety of businesses and in the absence of uniform cost accounting practice, there are no comprehensive standards for margin-fixing. An agreed price policy must be sufficiently generous for the preservation of the least efficient business unit accepting it. Once accepted by the trade, the fixed price becomes the fair price, and any price-cutting is regarded as an anti-social practice.

While the associations naturally aim at enrolling as members all the businesses in their respective trades, many seek to restrict the amount of competition by controlling the number of new entrants into distribution. Among the weapons mentioned by the author as used for this purpose, are the "distance limit" of the newspaper vendors and the technical qualification of the pharmaceutical chemists. What amounts to a financial qualification is also in use in cases where retailers can only obtain supplies conditional upon carrying adequate stocks in suitable premises, and providing proper servicing facilities. Many associations look forward to securing some form of licensing or registration of their members, as a means of achieving this end.

Perhaps the most striking sentence in the whole book runs as follows: "It is a surprising feature of the present-day structure of British industrial organisation that the country which once prided herself on being immune from any monopolist domination to-day not only possesses hardly a single industry or trade in which quasi-monopolist organisation is absent, but actually has remained the only important industrial country in which no legislation has been enacted to control their activities." War conditions have in many cases strengthened the positions of existing associations, while war-time regulations have sometimes forced them into being. At the moment of writing this review it has been announced that the Government has turned down the Retail Trade Committee's scheme for a compulsory levy on all traders, to be used for the purpose of compensating those who lose their businesses owing to war-time conditions, and in its place it is proposed to compile an official register of such persons, so that their prior right to re-enter their trades can be recognized after the war. Unless the implied restriction, which dangerously plays into the hands of the associations, is followed up by some measure of State control over the associations' policies, an opportunity for serious abuses will arise. Professor Levy recommends the setting up of a Government Department staffed by civil servants who can specialize in economic and commercial problems. Given adequate powers, the Department could then be made responsible for seeing that the activities of the associations are kept in harmony with public policy and the general interest.

T. M. R.

6.—*Measurement of Trees*. By Reginald Davey. Forest Press, Nutley, Sussex, 1942. 9½" × 6". 236 pp. 21s.

Most foresters experience the need for methods to cope with the variation inherent in their material—methods that have come to be known as statistical. The problems of variation, of sampling, of regression of one feature or measurement on another are all encountered in their daily work.

This book is for the practical man; its object is "to simplify the measuring of trees and woods for sale so that the exercise of care can secure results at present attainable only after years of practice." Some fifty pages are devoted to methods of measuring individual trees and a further fifty to tables based on English data. On these sections the reviewer does not feel competent to pass an opinion. The middle section, the remainder of the book, is the part that deals with the variation encountered and methods of coping with it. A chapter entitled "Theory of

Sampling" introduces the practical man to the ideas of distributions, skew and symmetric, standard deviation and the variation of estimates of mean and standard deviation made from samples. No reference to the distribution of  $t$  is made since the size of sample used in this work is usually large enough to make its use unnecessary. The formulæ are simplified by using  $\pm 2$  (standard deviation) for fiducial limits and quoting a corresponding confidence. The explanations are concise and in keeping with the purpose of the book. The extent to which a book of this kind can indulge in explanation is limited. This may sometimes make difficulties where none exist. One example, not perhaps very serious, is the formula for calculating standard deviation from a sample of 40 which shows division by 39 without the explanation that this number is one less than the number in the sample. One might cavil too at limits being given with 2:1 confidence as an alternative to the 21:1 confidence with the implication that such limits might sometimes be used. Cases in which one is prepared to accept a 2:1 confidence are surely rare.

The book is well produced, and the use of English data both in the examples and in the tables ought to encourage the use of statistical methods among English Foresters.

E. D. R.

7.—*An Essay on Marxian Economics*. By Joan Robinson. London: Macmillan. 1942.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . x + 122 pp. 7s. 6d.

In the Foreword the author declares that her aim is "to explain what she understands Marx to have been saying in language intelligible to the academic economist." It may be a little difficult to decide whether this is meant to be a reflection on Marx's intelligibility or on the academic economist's intelligence, but we may say that the book is so clearly written that it will not be beyond the intelligence of the average reader, pro or anti Marx, who is interested in

these matters, save for occasional references to the magical formula of  $\frac{e}{e-1}$ .

But these are not material to the argument, and may be skipped.

While this study is admittedly confined to Marx's economic analysis in the narrow sense, and completely ignores some of the most important parts of Marxian doctrine, Mrs. Robinson succeeds in giving us a satisfying and enlightening picture of the weaknesses and virtues of the economic analysis of *Das Kapital*. She points out how modern economics has moved away from orthodoxy towards Marxian theories in many ways. But there are exceptions, as in the curious differences between the wage theories of Marx and Mr. Keynes. The two agree, but for quite opposite reasons, on the uselessness of increasing wages at a time of crisis, while they completely disagree as to the effects of a fall in money wages during a crisis. This disagreement, the author maintains, can be finally settled only by detailed statistical analysis.

But Mrs. Robinson does more than merely explain Marx. For in throwing light on the likenesses and dissimilarities of the theories of orthodox and modern economists and of Marx, she brings into relief some of the more important problems which all three have ignored or failed to solve, and in doing so has many pertinent things to say about modern economics and economists. One may often hear criticism, not necessarily completely justifiable, of modern abstract theory, but there is additional piquancy when it comes from the author of *The Economics of Imperfect Competition*. She inveighs against modern obsessions with equilibrium, and denounces the almost complete divorce between abstract theory and realistic investigations as a standing reproach to economists. As she declares, the analysis of static conditions, if taken literally, is no more interesting than speculation as to what life is like on the moon. And one may well wonder how much Economics has had to pay in the past and may yet have to pay in the future for its archpriests' overlong devotion to elementary static abstractions. Mrs. Robinson suggests that a much-needed corrective is a greater use of the statistical approach, and, while realizing its limitations, she points out many directions in which the economist may, if not must, call in the aid of the statistician.

There is a singularly pathetic ring about her later admission that it has generally been the fate of economic theory to run a losing race against the course of history and never to have completed the analysis of one phase of economic development before another takes its place. But on a final note of hope, she concludes that when the economists begin to ask answerable questions, the statisticians will not despair of finding the answers. With this we need not disagree.

C. O. G.

## STATISTICAL NOTES

## BRITISH OFFICIAL STATISTICS

Very little change has taken place in the level of *general wholesale prices* during the third quarter of 1942. According to the Board of Trade Index Number (1930 = 100), there was a decline in the wholesale prices of articles of food and tobacco of about 2.4 per cent., and an increase in those of industrial materials and manufactures of 1.2 per cent. The result leaves the general index-number for all articles at nearly the same figure in September as in June, being 159.8 in the earlier and 159.7 in the later month. The most noticeable decreases were in the groups of cereals, which declined 3.7 per cent. (from 194.8 to 187.5), and of "other food and tobacco, which declined 3.1 per cent. (from 175.9 to 170.4). Prices of meat, fish and eggs remained stationary throughout the three months. There was a marked increase (10.5 per cent.) in the prices of coal, but apart from this increase, which took place in July, the only changes among industrial materials and manufactures were advances of between 1 and 2 per cent. in the prices of textiles other than cotton and of the miscellaneous group of materials. Building materials advanced about 2.5 per cent. Price-fixing and control of supplies tend to restrict variations in price, and over the twelve months ended September 1942 the only substantial changes in price were in the group of cereals (19 per cent.) and in that of coal (11 per cent.).

Since the commencement of the war food prices have advanced 73 per cent. and industrial materials and manufactures 58 per cent. The group of cereals shows the biggest advance, 123 per cent. Five other groups—cotton, wool, "other" textiles, "other" food (excluding meat, fish, and eggs)—and the miscellaneous group have advanced between 70 and 80 per cent. The group showing the smallest advance is that of non-ferrous metals (25 per cent.), but prices of most of these were fixed almost at the commencement of the war and their distribution controlled. Prices of the meat, fish, and eggs group have advanced about 38 per cent.

The index-number of wholesale prices prepared monthly by the Board of Trade is given below for the months June to September 1942.

(Averages for the Year 1930 = 100)

Date	Total Food	Total not Food	All Articles	Basic Materials	Inter-mediate Products	Manufactured Articles	Building Materials
June 1942	160.4	159.2	159.8	167.9	168.3	152.3	143.6
" "	161.3	160.6	161.1	167.8	169.2	152.7	144.7
Aug. "	157.5	160.8	159.9	167.1	169.2	153.4	146.1
Sept. "	156.5	161.1	159.7	167.3	169.4	154.0	147.3
Sept. 1941	147.1	157.7	154.3	170.4	166.7	149.1	140.3
Aug. 1939	90.4	102.2	98.1	94.5	104.0	108.7	104.1
Percentage increase in Sept. 1942 over—							
Sept. 1941	6.4	2.1	3.5	1.8*	1.6	3.2	4.9
Aug. 1939	73.1	57.7	62.9	77.0	62.9	41.7	41.5

\* Decrease.

The figures for certain other British index-numbers of wholesale prices and those of the United States Bureau of Labour are given below.

Date	Board of Trade (1930 = 100)	<i>Economist</i> (1927 = 100)	<i>Statist</i> (1866-77 = 100)	<i>The Times</i> (1913 = 100).	U.S. Bureau of Labour (1926 = 100)
June 1942 ... ..	159.8	110.7	154.4	181.6	98.4
July „ ... ..	161.1	111.6	150.0	175.4	98.5
Aug. „ ... ..	159.9	110.2	149.4	175.6	98.8
Sept. „ ... ..	159.7	112.8	149.7	176.3	99.3
Sept. 1941 ... ..	154.3	107.1	145.5	171.2	91.3
Aug. 1939 ... ..	98.1	70.3	90.4	114.5	74.8 *

\* Corrected figure.

During the third quarter of 1942 there has been little general change in the *cost of living* of working-class families as shown by the index-number prepared by the Ministry of Labour and National Service. Retail prices of food have risen slightly (1.9 per cent.). There were increases of 1*d.* per 4 lbs. in the average price of bread and 1½*d.* per 7 lbs. in the price of flour, and the average price of milk advanced from 8½*d.* to 9*d.* per quart. On the other hand, the price of potatoes fell about 2*d.* per 7 lbs. There was some decline—nearly 4 per cent.—in the prices of articles of clothing. This decline was due to the removal of Purchase Tax from “utility” apparel and cloth and to increased purchases of such apparel. Prices of utility cloth and clothing have been appreciably lower on the whole than those of non-utility goods of corresponding quality, and much larger quantities of them are now available. There was a general advance in July in the price of coal to the extent of 3*s.* per ton or 2*d.* per cwt. In addition, there were some slight advances during the three months in the prices of domestic ironmongery, pottery, brushes, and soap. The Ministry of Labour’s index-number is based on the retail prices at August 1914 of the principal articles of working-class consumption combined in accordance with their then relative importance; “no allowance has been made for any changes in the standard of living since that date or for any economies or readjustments in consumption and expenditure since the outbreak of war.”

The index-numbers at the undermentioned dates are given below.

(Prices at July 1914 = 100)

Date	Food	Rent and Rates	Clothing	Fuel and Light	Other Items	Total
July 1st, 1942 ...	160	164	405	232	264	200
Aug. 1st, „ ...	160	164	405	240	264	201
Sept. 1st, „ ...	160	164	395-400	240	265	200
Oct. 1st, „ ...	162	164	390	241	266	200
Oct. 1st, 1941 ...	165	164	385-390	229	231	199
Sept. 1st, 1939 ...	138	162	205-210	180-185	180	155
Percentage increase at Oct. 1st, 1942 over—						
Oct. 1st, 1941 ...	1.8 *	—	0.7	5.2	15.2	0.5
Sept. 1st, 1939 ...	17.0	1.2	88.0	32.1	47.8	29.0

\* Decrease.

The principal articles included under the heading "other items" are soap, soda, domestic ironmongery, brushes, pottery, tobacco and cigarettes, fares, and newspapers. Apart from the increases in the price of tobacco and cigarettes, due principally to the imposition of additional duties, the most noticeable increases have been in the prices of domestic ironmongery, brushes, glass, and pottery. These increases have been almost continuous since the beginning of the war, and must now be at least in the region of 100 per cent. Soap has also advanced in price considerably, and railway fares are higher in consequence of an increase of 10 per cent. in May 1940 and the abolition of cheap tickets. Omnibus and tram fares have also risen for many journeys.

Copies of *Part IV of the Final Report on the Fifth Census of Production* (1935) and of the *Final Summary Tables for the Fifth Census of Production* have been placed in the Library of the Royal Statistical Society by the Board of Trade. All students of economic affairs will welcome the appearance, at long last, of Part IV; it is in galley proof state, as the type was destroyed by enemy action in 1940. It is learned that only ten galley proofs are now in existence, but it is hoped that the value of this document will not deter Fellows from making use of the copy in the Library.

Taking the trades dealt with in Part IV, the net output of the *Paper, Printing and Stationery trades* rose from £93.9 m. in 1924 and £103.3 m. in 1930 to £111.7 m. in 1935; the average number of persons employed rose from 343,000 and 380,000 to 409,000, while the net output per head was practically constant in the three years. For the group as a whole, net output per head showed a definite upward trend with the size of establishment, the figure for establishments employing 11–24 persons being £194, while that for the largest establishments (1,500 persons and over) was £428; the same general trend was apparent for size of firm, although in this case the penultimate group (2,500–3,999) recorded the largest net output per head (£422). The net output of the *Timber trades* in 1935 was £37.3 m., compared with £31.4 m. in 1930 and £27.3 m. in 1924; the average number of persons employed rose from 138,000 in 1924 to 168,000 in 1930 and 195,000 in 1935, while net output per head in the three years was £199, £188, and £191. Unfortunately, timber was not always a heading in the "materials purchased" table for the trades in which timber is used in significant quantities, so that it was not possible to include a table (similar to the one for different types of steel products in Part II) showing the distribution among the various trades of the total quantity of softwoods and hardwoods available for consumption by home industry. However, with a little ingenuity and a lot of estimation, the main outlines of such a table can be constructed, bearing in mind among other things, that neither softwoods nor plywoods are specified as materials in the furniture trade, and that timber purchased and used by coal-mines and railway companies is recorded by value only. Perhaps the next Census will attempt to fill this gap. The number of employees in the *Clay and Building Materials trades* increased from 209,000 in 1924 to 224,000 in 1930 and 249,000 in 1935; net output per head in the three years was £209, £201, and £217, and the fall in 1930 and rise in 1935 were followed in all trades except cement, where an increase was recorded from £341 in 1924 to £430 and £564 in the subsequent censal years. For building bricks, the volume of output was 55, 67,

and 92 in 1924, 1930, and 1934 (1935 = 100), for glass 62, 72, and 93, for cement 57, 85, and 94, and for building materials 55, 88, and 93; only china and earthenware had a smaller output in 1930 than in 1924, the figures being 96, 89, and 94. The share of wages in net output in each trade was lower in 1935 than in 1930, the proportions for cement being 22·8 and 32·8, in spite of a high, and increasing, net output per head. The final report on the *Building and Contracting trade* is one of the most valuable of those under review, because the information is far more comprehensive than was given in the preliminary report, and also because the latter was, in fact, greatly defective, as a large number of returns had not been completed in time for inclusion therein. The results now available are of first-rate importance, not only for a study of the vagaries of the building trade itself, but also from the viewpoint of the "post-war planner." In 1935, 502,000 were employed, compared with 454,000 in 1930 and 419,000 in 1924. The total value of building and contracting work recorded on the schedules for that industry was £192,217,000 in 1930 and £213,126,000 in 1935. Sub-contract work was separately distinguished in 1935, for the first time, and £19,030,000 was recorded as such in the trade, and £6,284,000 in other trades; in addition, of the £15,266,000 recorded for goods made and used by firms in other trades in carrying out contracts, £3,100,000 was estimated as being used on sub-contract work. Building and contracting output recorded for other trades was £31,643,000, and for Public Utility undertakings and Government Departments £116,212,000. Small firms are estimated to have employed 255,000, with an output of about £83,000,000, and dividing this into new construction, repairs and other contracting work on the basis of information obtained at the 1924 Census, and excluding sub-contract work (the value of which is assumed to be duplicated elsewhere), the report estimates the value of all building and contracting work done in 1935 as £422,000,000, of which new construction accounted for £179,000,000, repair and maintenance for £101,000,000, and other contracting work for the remainder. For mines and quarries, public utilities and government departments, there is, generally speaking, later information now available than is given in the census, although not in such detail, so that the census is still the most authoritative source on many questions.

*The Final Summary Tables* provide a picture of the census industries as a whole. All the main aspects dealt with in the summary volume for the 1930 Census are covered in this new compilation, except for volume of production, specialization in industry, and comparison of total output with imports and exports; as no text is furnished with the summary tables, one can assume that these omissions are due to wartime pressure of work. The total net output of the Census trades rose from £1,503·5 m. in 1930 to £1,625·1 m. in 1935. Net output per head rose from £211 in 1930 to £222 in 1935; proportionately, the largest increase was for iron and steel (+16 per cent.) and the largest decrease for clothing (−5 per cent.). Tables are given showing the distribution, by size-groups, of establishments and firms (for the factory trades) and of firms (for the non-factory trades). For the factory trades, the importance of the small firm seems to have declined; for although the firms employing 11–99 persons represented 76 per cent. of all firms covered by the Census in both 1930 and 1935, the proportion of net output accounted for by these firms fell from 22·5 per cent. to 19·8 per cent.; in addition, the number of firms employing ten persons



or less fell from about 160,000 to 132,000. An interesting feature of the development of British industry has been the increase in the proportion of administrative, technical and clerical staff in total employment. This proportion was 7.0 per cent. in 1907 and rose to 8.7, 10.2, and 11.4 in the subsequent censal years. A most useful table summarises the available information on wages. The total wage bill of the census trades (excluding Public Utility Services and Government Departments) is estimated at £687 m. in 1935 and £678.5 m. in 1930 (for the United Kingdom), and at £725 m. in 1924 (for Great Britain). For the firms furnishing returns of wages, average earnings per operative were £119 per annum in 1935 and 1930 and £122 in 1924, while net output per operative rose from £227 in 1924 and 1930 to £244 in 1935. The share of wages in net output consequently fell from 53.7 per cent. in 1924 to 52.3 per cent. and 48.8 per cent. in the later years. Detailed area tables are given showing the principal trades in each area, together with summary particulars; these should be useful to students of localization of industry. Particulars of consumption of coal and coke, and of electricity, by individual trades, are also given.

There was little change during the third quarter of 1942 in the number of workpeople recorded as *unemployed*. The number of adult men and women on the registers declined by 8,730, but there was an increase in the number of juveniles of 6,668, due almost entirely to the registration of boys and girls on leaving school. The total number of unemployed workers on the registers of the Employment Offices of the Ministry of Labour and National Service at September 14th, 1942, was 104,108, of whom 98,662 were wholly unemployed, 2,709 were temporarily suspended, and 2,737 were persons who ordinarily seek their livelihood by jobs of short duration. In addition, to the 55,661 men who were recorded as unemployed, there were 23,227 men who had been classified by interviewing panels of the Ministry as unsuitable for ordinary industrial employment and, in addition to the 25,274 women similarly recorded, 1,084 were classified as unsuitable for normal full-time employment. The 25,274 women recorded as unemployed included 1,080 who were unable for good cause to transfer to another area. The following table gives the numbers recorded as unemployed for the period June to September 1942, with comparative figures for September 15th, 1941, and August 14th, 1939. The figures for September 1941 have been amended to exclude those men and women classified as unsuitable for ordinary industrial work.

Date	Wholly Un-employed	Temporarily Stopped	Persons normally in Casual Employment	Total	Males	Females
June 15th, 1942 ...	99,240	3,670	3,260	106,170	67,629	38,541
July 13th, „ ...	101,436	3,264	2,305	107,005	70,024	36,981
Aug. 17th, „ ...	107,534	3,622	2,669	113,825	75,622	38,203
Sept. 14th, „ ...	98,662	2,709	2,737	104,108	67,832	36,276
Sept. 15th, 1941 ...	162,655	23,973	10,054	196,682	87,021	109,661
Aug. 14th, 1939 ...	968,108	211,978	51,606	1,231,692	947,099	284,593

The returns prepared by the Bank of England in conjunction with various retail distributors' associations show that the value of *retail sales* for the first seven months of the trading year commencing February 1942 was 2.3 per cent. greater than in the corresponding months of 1941. Sales of food and perishables were 3.7 per cent. greater, and those of other merchandise 0.5 per cent. greater. The largest increases were in London, Central and West End (16.3 per cent.) and London, Suburban (5.7 per cent.). A decrease of 2.3 per cent. took place in the South of England, and in the Midlands and South Wales there was an increase of less than 1 per cent. The stocks at the end of August 1942 were 5.5 per cent. more than at the end of August 1941. Bearing in mind the continued increase in prices, especially of merchandise other than food, the small increase in the value of sales indicate a substantial reduction in the quantity of goods sold.

### CURRENT NOTES

Some figures of the salaries and cost of living of women teachers fifty years ago, supplied by Miss Clara Collet, make an interesting and encouraging footnote to Mr. Massey's investigation of middle-class budgets (pp. 159-185 of this issue). They were originally given in a paper read by Miss Collet at a meeting of the University Association of Women Teachers and published in the *Journal of Education*, August 1890. The aim of the paper was to urge that a determined attempt should be made to improve the salaries paid to graduate women teachers by using the trade-union methods against which there was in those days so much prejudice among the professional classes. The Association was asked to insist on a minimum initial salary (non-residential) of £100 a year for its members and to expel any who accepted less. Many were enabled to do so by living at home or receiving allowances from their families, and they thereby

#### *Cost of Living*

	Salary £80			Salary £100			Salary £120			Salary £150		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Board and Lodging during Term, say 40 weeks ... ..	42	0	0	50	0	0	50	0	0	60	0	0
Half rent during holidays ... ..	3	0	0	4	0	0	4	0	0	5	0	0
Railway and other expenses for six weeks of holidays with friends ... ..	3	0	0	4	0	0	4	0	0	4	0	0
Six weeks of holidays at own expense ... ..	7	10	0	9	0	0	12	0	0	15	0	0
Educational books ... ..		10	0	1	0	0	2	0	0	3	0	0
Dress ... ..	14	0	0	15	0	0	15	0	0	20	0	0
Petty Cash for omnibuses, amusements, presents, charities, etc., etc. ... ..	3	0	0	4	10	0	6	0	0	9	0	0
Laundry ... ..	3	10	0	3	10	0	3	10	0	3	10	0
Medical attendance and provision against sickness ... ..	3	10	0	5	0	0	7	10	0	7	10	0
Sum available towards provision for old age ... ..	0	0	0	4	0	0	16	0	0	23	0	0
	£80 0 0			£100 0 0			£120 0 0			£150 0 0		

depressed the standard of living of those not so subsidized, to the detriment of their efficiency, physical, mental, and social. The grades of salary selected as representative were £80, £100, £120, £150, £80 being, the author thought in 1890, generally admitted to be "the lowest sum on which teachers of the social position required in our high schools can manage to live". The table reproduced on p. 251 of estimated cost of living, "carefully compiled by Mr. A. Pollard with the aid of experts", shows how the teachers might manage it, though Miss Collet thought such a mode of living could be tolerated for a year at most. Indeed, board and lodging at a trifle over a pound a week could not, even fifty years ago, have yielded much satisfaction, nor do six weeks "holidays at own expense" at £1 1s. a week promise exhilaration. The corresponding holidays for teachers in receipt of £120 and £150 a year are reckoned at £2 and £2 10s. respectively, "allowing for an occasional holiday abroad," which seems over-hopeful in a period of normal exchange rates. On the other hand, given a fair stock of clothes to start with, a few pounds could possibly have been saved on that item in all the budgets. It may incidentally be wondered if many of the women in receipt of £150 really put aside £23 in any one year as provision for old age.

A plea for the improvement of official statistics has been made by Mr. Alec Cairncross in an article on "The Higher Civil Service after the War," which appeared in the *Journal of Public Administration* (July–September 1942). His experience in assisting those responsible for the conduct of affairs during the war moves him to assert that the background available for guidance in the shaping of policy does not include adequate statistical records. Among the "many necessary series" not provided by the departments he cites the absence, before the war, of any official estimate of national income. He points to the want of organization exemplified in the three different kinds of industrial classification used by three different departments, and to the failure of the Civil Service to recognize that statistics really matter, illustrated by the disbanding at the outbreak of war of the Census of Production Staff and the stoppage of the collection of unemployment and of railway returns. In spite of the setting up of the Central Statistical Office, "there is no reason to believe that all Government Departments collect the returns that are indispensable to the efficient transaction of business; it is certainly notorious that many of the returns which they collect are based on ill devised questionnaires, are intended to elicit information already available, or contain a mass of figures of which no real use is made." Mr. Cairncross would have it laid down that every department should have its own statistician, whose function should be "to ensure that figures that are really necessary are properly collected and properly kept." He would also like to see a Central Intelligence Section in each department, "to provide information, to put up ideas, and to offer comment on Cabinet papers." Such a section would evidently need to be in close touch with the departmental statistician and with the Intelligence Sections of the other departments.

As announced in the *Journal* (Part IV, 1941, p. 395), it was found impracticable to continue the regular work of the Industrial and Agricultural Research Section during the war. Individual Members of the Section and others are, however, engaged in applying the statistical methods of quality control to the production

of war material, and have felt the need for organised discussion of the problems that arise in their work. The Council has therefore agreed to the formation of a war-time Industrial Applications Group to which questions relating to method and interpretation, views on the merits of alternative procedures, and so forth, can be brought for informal discussion. The first meeting was held on Friday, December 18th, at 6.30 p.m., by the courtesy of the Electric Lamp Manufacturers Association, in their premises on Savoy Hill. The subject was The Relation between Design Tolerance and "Control Limits" in Manufacture, and the discussion was opened by Dr. B. P. Dudding M.B.E., of the General Electric Company's Research Laboratories. Invitations were not confined to Members of the Section but were sent to a number of institutions and firms concerned with the manufacture of war material; the meeting was well attended and the discussion was lively and instructive.

# STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS

## UNITED KINGDOM—

*Agenda*—Vol. 1, No. 3—Some thoughts on reconstruction: *C. R. S. Harris*. The future of information services: *R. B. McCallum*. Collection of population statistics: *E. C. Rhodes*. United States foreign trade policy: *E. F. Schumacher*. Agriculture in Soviet Russia and post-war needs: *Sir John Russell*.

*Agriculture*—September 1942—Fertilizer policy on the farm: *E. M. Crowther*. *The Banker*—

September 1942—Civil Service: a defective machine. Incomes and taxation. Sharing the costs of the war: *E. H. Stern*. Australia's expanding war effort: *D. F. Kerr*.

October 1942—The finances of refugee Governments: *Paul Bureau*.

November 1942—The economics of Dr. Temple.

*Economica*—August 1942—National income in America and the United Kingdom: *A. L. Bowley*. The distribution of incomes: *E. C. Rhodes*.

*Eugenics Review*—July 1942—Social factors in psychiatry: *W. Lindesay Neustatter*. Juvenile delinquency: *C. D. Rackham*.

*Institute of Bankers, Journal*—October 1942—Anti-inflation measures in the United States: *Dr. Harold Stonier*.

*Institute of Statistics, Oxford, Bulletin*—

Vol. 4, No. 11—The aluminium revolution: *S. Moos*. Differential rationing: *M. Kalecki*. A new plan for the non-food retail trade: *G. L. Nicholls*.

Vol. 4, No. 12—The distribution of incomes: *J. L. Nicholson*. The new building programme: *J. Goldmann*. Compensation in practice: *T. Balogh*. Salvage of waste material: *D. B. Halpern*.

Vol. 4, No. 13—The financial situation in the first half of 1942: *M. Kalecki*.

Vol. 4, No. 15—Utility goods: *P. Ady*. Beer in war-time: *J. Goldmann*. The fall in "small" savings: *M. Kalecki*.

Vol. 4, No. 16—Reorganisation of inland transport: *E. J. Buckatsch*. Incentives to the development of mineral resources: *S. Moos*.

Vol. 4, Supplement No. 3—Working class budgets: June 1942.

*Manchester School*—October 1941—Some disguised blessings of the war: *H. W. Singer*. Local authorities and housing subsidies since 1919. Price leadership in the rayon industry: *Edgar Jones*.

*Manchester Statistical Society, Transactions*—Session 1940-41—Inflation: *Jack Stafford*. Education in economics: *J. R. Hicks*. Migration in the Manchester area: *W. H. Mounsey*. The social policy of Nazi Germany: *C. W. Guillebaud*.

*Public Administration*—July-September 1942—Equal educational opportunity: what it means: *Lady (E. D.) Simon*. The higher Civil Service after the war: *Alec Cairncross*. In the meanwhile: *Edmund Lund*. Reorganisation of Local Government areas: *James Lythgoe*.

*Review of Economic Studies*—Summer 1942—A reconsideration of the theory of tariffs: *T. de Scitovsky*. The precision of national income estimates: *Richard Stone*, *J. E. Meade* and *D. G. Champenowne*. Consumers' surplus and index numbers: *J. R. Hicks*. Income burden of capital taxes: *N. Kaldor*.

*Royal Meteorological Society, Quarterly Journal*—October 1942—Notable falls of rain during intervals of a few days in Great Britain: *E. L. Hawke*.

*Sociological Review*—Vol. 34, Nos. 1 & 2—Loudon Square: a community survey. 1: *K. L. Little*. Chaos in the Social Services: *Barbara Wootton*. The Social basis of physical planning: *R. E. Dickinson*.

## INDIA—

*Indian Journal of Economics*—July 1942—An enquiry into indebtedness in a Mysore village: *M. H. Gopal*.

## UNION OF SOUTH AFRICA—

*South African Journal of Economics*—March 1942—Fundamentals of economic policy in the Union: *Professor C. S. Richards*. Economic welfare and the development of the Native reserves: *M. N. Franklin*.

## UNITED STATES OF AMERICA—

*American Economic Review*—September 1942—The burden of a domestic debt: *B. U. Ratchford*. Price control and rationing: *Donald S. Tucker*. *American Statistical Association, Journal of*—

March 1942—Government and the statistician: *Winfield W. Riefler*. The effect of the full moon on trout fishing: *C. M. Mottley* and *Daniel R. Embody*. Proposed annual sample census of population: *Philip M. Hauser*. Relative efficiencies of various sampling units in population inquiries: *Morris H. Hansen* and *William N. Hurwitz*. Recent developments in sampling for agricultural statistics: *George W. Snedecor* and *Arnold J. King*. The meaning of productivity indexes: *W. Duane Evans* and *Irving H. Siegel*.

September 1942—Application of statistical methods to ordnance engineering: *Leslie E. Simon*. Tests of significance considered as evidence: *Joseph Berkson*. The statistical work of the League of Nations in economic, financial and related fields: *Charles K. Nichols*. Market forecasting significance of market movements: *L. C. Wilcoxon*. Use of inversions as a test of random order: *A. C. Rosander*. Correlation analysis by margins: *E. J. Broster*. Standard error of percentiles: *W. Duane Evans*. The use of tests of significance in an agricultural experiment station: *George W. Snedecor*. Mechanization of statistical drafting: *R. von Hulm*.

*Econometrica*—July-October 1942—The foundations of welfare economics: *Oscar Lange*. Compounding probabilities from independent significance tests: *W. Allen Wallis*. Certain tests for randomness applied to data grouped into small sets: *Edward L. Dodd*.

*Harvard Business Review*—Summer Number 1942—An approach to post-war planning: *R. P. Gustin* and *S. A. Holme*. Population changes and their effects: *Henry L. Duncombe, Jr.* Information in advertising: *Kenneth Dameron*.

*Journal of Political Economy*—August 1942—Advertising expenditures: a suggested treatment: *Norman S. Buchanan*.

*Milbank Memorial Fund Quarterly*—July 1942—A concept of deficiency states: *H. D. Kruse*. The severity of illness among males and females: *Sally Preas* and *Ruth Phillips*. Food rationing and mortality in Paris, 1940-1941: *Ramon F. Minoli*.

*Quarterly Journal of Economics*—August 1942—Market classifications in modern price theory: *Joe S. Bain*. Fiscal policy and income determination: *Paul A. Samuelson*.

*Review of Economic Statistics*—August 1942—Earnings and employment in the business cycle: *Josef Herbert Furth*. The relation between size and efficiency of business: *John M. Blair*. The political economy of consumers' rationing: *T. de Scitovszky*. What it takes to block inflation: *Albert Gailord Hart*.

*Social Research*—September 1942—World oil control, past and future—an alternative to "International cartelization": *Frederick Haussmann*.

## SWITZERLAND—

*Zeitschrift für Schweizerische Statistik und Volkswirtschaft*—

June 1942—No. 3. Die Lehre vom Handel: *Professor Dr. Richard Buchner*.

August 1942—Ist die Inflationstheorie ein Irrweg? *Dr. Walter Jöhr*.

## INTERNATIONAL—

*International Labour Review*—

August 1942—Wartime developments in German wage policy: *Rene Livchen*.

September 1942—Food consumption and nutrition in the Americas: *Robert Morse Woodbury*.

## LIST OF ADDITIONS TO THE LIBRARY

Since the issue of Part II, 1942, the Society has received the publications enumerated below:—

## I.—OFFICIAL PUBLICATIONS

## (a) United Kingdom.

*Health, Ministry of.*

First and second interim reports of the Medical Personnel (Priority) Committee. London: H.M.S.O., 1942.  $9\frac{1}{2}'' \times 6''$ . 12 pp. 2d.

Summary report by the Ministry of Health for the period from 1st April 1941 to 31st March 1942. London: H.M.S.O., 1942. Cmd. 6394.  $9\frac{1}{2}'' \times 6''$ . 35 pp. 6d.

*Industrial Health Research Board.* The personal factor in accidents. (Emergency Report No. 3.) London: H.M.S.O., 1942.  $9\frac{1}{2}'' \times 6''$ . 19 pp. 4d.

*Medical Research Council.* Report of the Committee on Tuberculosis in War-Time. (Special Report Series No. 246.) London: H.M.S.O., 1942.  $9\frac{1}{2}'' \times 6''$ . 36 pp. 9d.

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# JOURNAL OF THE ROYAL STATISTICAL SOCIETY

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### MEASLES AND WHOOPING-COUGH INCIDENCE BEFORE AND DURING THE DISPERSAL OF 1939-41

By PERCY STOCKS, M.A., M.D.

IN a previous paper \* the behaviour of diphtheria and scarlet fever during 1939 and the first half of 1940 was studied by grouping the administrative areas of England and Wales according to their urbanization and classification in the scheme for the dispersal of school children. Measles and whooping cough were made notifiable throughout the country on October 23rd, 1939, the obligation to notify being laid upon medical practitioners who attended cases, but not upon other persons. It was possible, therefore, to assemble the notification statistics by areas between November 1939 and mid-1941. The two diseases, notwithstanding that the one is believed to be caused by a virus and the other by a bacillus, have several features in common; they attack large proportions of all children who live in densely populated areas, they are believed to be spread by droplet infection, are very infectious in the early stages before they can be diagnosed and are commonly followed by respiratory complications. The notifications do not represent the full incidence of these diseases, since there is no obligation to call in a doctor, and many children suffering from attacks of mild or moderate severity are never seen by one, and consequently escape notification. Nevertheless, during the two years 1940-41 nearly 800,000 children under 15 must have been notified for measles, and if this continued throughout 15 years the total in that period would be 6 million, implying that about 70 per cent. of children born would be notified before their fifteenth birthday. It has been estimated that 90 per cent. or more of London children have recognizable measles by that age, but in England and Wales as a whole the proportion is probably below 80 per cent. It follows that either the bulk of measles cases were notified or else measles incidence was unusually great in 1940-41, making the estimate of 6 million in 15 years too high. But even if the proportion of cases notified is somewhat lower than the statistics of the first two years suggest, the proportion is not likely to vary according to locality sufficiently to invalidate comparisons of notification rates in groups of areas. It seems likely that this can be said of whooping cough as well. Notifications in 1940-41 totalled about 225,000, and if they continued at that rate it would mean that about 20 per cent. of children born would be notified before their fifteenth birthday. The estimated incidence of whooping cough in London children before reaching that age is about 60 per cent.,† but in the country as a whole it may well be below 40 per cent.

\* "Diphtheria and Scarlet Fever Incidence during the Dispersal of 1939-40." *Journal*, 1941, CIV, Pt. IV.

† "On the Epidemiology of Whooping Cough in London." *Journal of Hygiene*, 1932, XXXII, No. 4.

*Measles.—Maximal, Minimal and Average Numbers of Deaths in each Quarter of the Year in Decennial Periods for Four Large Towns, 1871–1940*

Town	Period	Maximum No. of deaths in each quarter				Minimum No. of deaths in each quarter				Average No. of deaths in each quarter				Average quarterly deaths per cent. of annual deaths			
		1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
London A.C.	1871–	825	849	666	1,420	120	215	165	138	431	471	319	576	24	26	18	32
	1881–	1,106	1,227	937	1,488	238	247	218	293	573	831	500	627	22	33	20	25
	1891–	1,494	1,632	753	1,167	162	298	238	184	671	930	439	517	26	37	17	20
	1901–	1,155	932	437	844	251	477	207	136	576	679	313	427	29	34	16	21
	1911–	1,581	946	412	788	69	91	51	23	605	521	188	229	39	34	12	15
	1921–	907	841	62	260	10	21	10	4	366	265	37	86	46	35	5	14
Birmingham	1931–40	467	441	31	68	1	—	—	—	118	131	14	17	42	47	5	6
	1871–	78	239	60	103	6	5	8	7	33	48	24	47	22	31	16	31
	1881–	132	169	94	174	7	13	18	15	56	62	42	59	26	28	19	27
	1891–	203	212	152	132	—	1	3	3	56	69	43	53	25	31	20	24
	1901–	362	153	99	66	—	2	3	3	95	72	31	37	40	31	13	16
	1911–	272	219	80	450	8	26	11	2	83	80	29	87	30	29	10	31
Liverpool	1921–	93	80	34	29	2	16	1	1	41	45	12	10	38	42	11	9
	1931–40	92	75	14	31	1	—	1	—	21	20	6	5	40	39	12	9
	1871–	379	257	132	344	9	11	15	17	117	113	64	101	30	28	16	26
	1881–	313	358	234	370	9	7	23	8	130	165	100	147	24	31	18	27
	1891–	215	168	102	123	28	18	25	34	73	102	57	78	24	33	18	25
	1901–	269	285	221	322	3	25	10	7	97	132	68	92	25	34	17	24
Manchester and Salford	1911–	282	262	243	312	17	8	2	10	93	142	74	77	24	37	19	20
	1921–	223	181	108	215	5	22	8	4	83	91	41	54	31	34	15	20
	1931–40	275	175	52	112	—	—	—	—	77	57	17	36	41	31	9	19
	1871–	148	273	98	130	18	12	7	8	89	124	59	8	26	35	17	22
	1881–	365	549	186	292	29	13	15	19	122	151	77	19	26	33	17	24
	1891–	262	464	333	358	51	57	33	31	147	197	126	31	24	33	21	22
Manchester and Salford	1901–	226	333	186	216	30	59	41	20	111	167	96	20	23	35	20	22
	1911–	333	340	86	120	18	51	1	2	123	181	46	2	31	46	12	11
	1921–	135	426	221	163	1	1	1	—	50	93	37	—	23	44	17	16
	1931–40	145	40	13	92	—	—	—	—	43	13	4	—	51	15	5	29

*Whooping Cough.—Maximal, Minimal and Average Numbers of Deaths in each Quarter of the Year in Decennial Periods for Four Large Towns, 1871-1940*

Town	Period	Maximum No. of deaths in each quarter				Minimum No. of deaths in each quarter				Average No. of deaths in each quarter				Average quarterly deaths per cent. of annual deaths			
		1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
London A.C.	1871-	1,956	1,600	943	863	478	506	246	274	1,009	849	492	524	35	30	17	18
	1881-	2,224	1,516	823	828	411	403	295	202	1,009	832	474	448	37	30	17	16
	1891-	1,473	1,188	619	843	511	448	204	170	769	649	415	354	35	30	19	16
	1901-	760	677	469	414	364	334	163	96	522	492	258	209	35	33	18	14
	1911-	795	666	206	199	40	28	45	41	336	315	132	105	38	35	15	12
	1921-	733	335	146	165	49	43	22	17	285	159	73	75	48	27	12	13
Birmingham	1931-40	174	127	65	66	—	—	4	6	85	64	37	31	39	29	17	15
	1871-	211	121	96	125	55	57	35	25	102	83	56	63	34	27	18	21
	1881-	142	134	111	91	28	31	6	17	81	67	55	55	32	26	21	21
	1891-	150	149	82	104	33	40	22	21	93	74	44	47	36	29	17	18
	1901-	162	241	62	52	23	25	15	13	76	80	30	32	35	36	14	15
	1911-	183	202	40	65	10	18	3	4	85	78	24	25	40	37	11	12
Liverpool	1921-	193	120	42	41	12	10	2	5	60	47	21	18	41	32	15	12
	1931-40	86	50	23	49	6	1	5	1	26	23	11	14	35	31	15	19
	1871-	269	241	219	197	49	33	21	46	140	132	104	95	30	28	22	20
	1881-	144	249	133	107	72	43	17	20	105	129	79	66	28	34	21	17
	1891-	218	201	107	121	48	49	26	32	104	110	68	63	30	32	20	18
	1901-	217	163	89	148	16	26	18	26	103	97	54	60	33	31	17	19
Manchester and Salford	1911-	234	99	75	91	7	9	9	10	84	69	37	35	37	31	16	16
	1921-	127	99	42	45	20	25	10	10	63	60	30	28	35	33	16	16
	1931-40	73	81	41	74	3	2	5	2	36	29	17	20	36	28	17	19
	1871-	358	181	102	186	55	43	30	31	158	123	73	86	36	28	17	19
	1881-	179	237	100	136	69	57	51	44	112	124	62	68	31	34	17	18
	1891-	218	284	105	125	63	94	59	36	144	167	76	70	31	37	17	15
Manchester and Salford	1901-	112	242	152	75	60	65	20	17	91	133	68	44	27	40	20	13
	1911-	217	203	58	43	10	8	3	4	76	96	22	22	35	45	10	10
	1921-	229	136	44	59	11	22	11	8	67	65	22	23	38	37	12	13
	1931-40	48	38	18	26	3	3	1	1	23	20	10	9	38	32	16	14

In order to judge of the trend of these diseases before the dispersal began it is necessary to rely upon deaths, bearing in mind the great decline in fatality and the influence of season upon fatality. This can be done with advantage for some of the large towns, for which the quarterly deaths since 1871 were extracted from the records some years ago for another purpose. Several facts which have an important bearing on the discussion of recent events became evident from analysis of these data, and I propose to put them on record before proceeding to the notification data of 1940-41.

(1) *Deaths in the Largest Towns of England and Wales, 1871-1940*

The tables give the maximal, minimal and mean numbers of deaths from measles and whooping cough in the specified quarter of the year during each decennium for London administrative county, Birmingham, Liverpool and Manchester with Salford. In the right-hand columns are shown the percentage quotas of the decennial totals falling in each quarter. Similar data were obtained for Bristol, Leeds and Sheffield, but from considerations of space only the final ratios calculated from them are given in this paper. For whooping cough the seasonal distribution of deaths showed little change over the 70 years in London, 65 to 75 per cent. occurring in the first half of the year, but a slight increase in the quota of the first quarter occurred at the expense of the fourth quarter. In Birmingham the first half of the year tended to take a slightly larger share in recent decades, and this was true also of Liverpool and Manchester. Leeds and Sheffield showed a similar change to London, but in Bristol the seasonal distribution did not change consistently. For measles, however, the position has been very different. In London the fourth quarter had about one-third of the deaths in 1871-80, but its quota declined steadily to only 6 per cent. in 1931-40; and the third quarter had about one-fifth of the deaths during 1871-90, but only 5 per cent. during 1921-40. Birmingham showed a similar progressive change in the seasonal distribution, the second half of the year having 47 per cent. of the deaths in 1871-80, decreasing to 21 per cent. in 1931-40, and the same was true of Bristol (46 per cent. declining to 12), Sheffield (50 to 25), Leeds (49 to 27) and Liverpool (42 to 28), but Manchester and Salford did not show such a consistent change.

This pronounced change in the seasonal distribution of measles deaths is represented below in a different way. In London the child population, as estimated by the births in the first half of the decade, was about half as great in 1931-40 as in 1871-80, but measles deaths in the fourth quarters decreased to only 3 per cent. of the 1871-80 figure and in the third quarters to 4 per cent., whereas in the first and second quarters they were 27 and 28 per cent. respectively. The risk to a child of dying from measles during the first half of a year was, therefore, halved in the course of the 60 years, whilst for the second half of the year it fell to about one-fifteenth.

The other towns show a similar contrast between the quarters, most pronounced in Bristol, Sheffield, Leeds and Birmingham and least in Manchester, in the rate of decline of measles deaths. The corresponding ratios for whooping cough, given for comparison, do not, except in Leeds and Sheffield, show any remarkable variation according to the time of year. It is apparent that the mortality of measles during summer and autumn has declined to a far greater extent than during winter and spring.

*Measles and Whooping Cough.—Proportionate Decrease in Deaths from 1871-80 to 1931-40 in each Quarter, compared with the Proportionate Change in Children at Risk in Seven Large Towns*

Town	Births in 1931-35 per cent. of 1871-75	Deaths in 1931-40 per cent. of 1871-80 in each quarter							
		Measles				Whooping Cough			
		1st	2nd	3rd	4th	1st	2nd	3rd	4th
London A.C. ...	53	27	28	4	3	8	8	8	6
Birmingham ...	113	64	42	25	16	25	28	20	22
Liverpool ...	95	66	50	27	36	26	22	16	21
Manchester and Salford ...	80	48	10	7	33	15	16	14	10
Leeds ...	66	46	34	13	8	21	17	14	6
Sheffield ...	73	26	23	13	4	13	15	15	7
Bristol ...	88	72	15	6	4	13	12	12	11

Remarkable changes have occurred for both diseases in the ratio of maximal to minimal deaths registered in a given quarter. In London these ratios in successive decennial periods were:—

		1871-	1881-	1891-	1901-	1911-	1921-	1931-40
<i>Measles</i>	1st quarter ...	7	5	9	5	23	91	467
	2nd „ ...	4	5	5	2	10	40	441/0
	3rd „ ...	4	4	3	2	8	6	31/0
	4th „ ...	10	5	6	6	34	65	68/0
<i>Whooping Cough</i>	1st „ ...	4	5	3	2	20	15	174/0
	2nd „ ...	3	4	3	2	24	8	127/0
	3rd „ ...	4	3	3	3	5	7	16
	4th „ ...	3	4	5	4	5	10	11

In 1901-10 the variability in deaths from year to year was comparatively small; for the second quarter, for example, the highest number was double the lowest for both diseases. Since then the rise and fall have become increasingly pronounced, and the troughs of the waves sank so low in 1931-40 as to leave many quarters free of deaths in the inter-epidemic periods. In Manchester and Salford the range of variability was lowest for measles in 1891-1900 for the first quarter and in 1901-10 for the other quarters, but it became very high by 1921-30 (135-426), and in 1931-40 each quarter had no deaths in at least one year. For whooping cough the ratios were 2 or 3 in 1891-1900, but ranged from 11 to 25 in 1911-20 and from 13 to 26 in 1931-40. In Liverpool the ratios in 1891-1900 ranged from 4 to 9 for measles, and were 4 in each quarter for whooping cough, but in 1911-20 the ranges were 17 to 121 and 8 to 33 respectively, and in 1931-40 each quarter was free of measles deaths in one or more years. Birmingham, however, passed through a period of high variability in 1891-1900, but for whooping cough the ratio has tended to increase progressively. The general trends of the average and minimal figures for these large towns during the last three decades lead to the expectation that both measles and whooping cough may soon become unimportant as causes of death.

In order to study the periods of the year in which epidemics of measles began,

an "epidemic" was defined as an occasion when the deaths recorded in at least one quarter were  $1\frac{1}{2}$  times the ordinate, at the year in question, of a graph obtained by plotting the average deaths for that quarter in successive decennial periods on a time scale. The beginning of the epidemic was estimated by locating the first fortnight in which the deaths recorded reached one-fourth of the total deaths in the quarter expected from the graph, and allowing a lag of 2 weeks between the rise in incidence and the rise in deaths. This method can only be approximate owing to variations in fatality with season, and the difficulty of defining what constituted an epidemic, but the errors involved in it are not likely to affect the broad grouping used in the following table to any appreciable extent. The result shows that, out of 213 epidemics as thus defined during the 67 years 1871–1937 in the 7 towns, 89 began during the Michaelmas term, 77 between Christmas and Easter, 47 in the Summer term and none in August. In Liverpool, Leeds and Sheffield 9 or 10 epidemics began in the Summer term, whereas in Manchester there were only 2.

*Distribution of 213 Measles Epidemics according to Week of Commencement as Estimated from Deaths, 1871–1937*

Town	No. of epidemics starting in the weeks indicated							Total
	Michaelmas term		Christmas-Easter		Summer term		August 31-34	
	35-42	43-50	51-6	7-14	15-22	23-30		
London A.C. ...	6	7	1	5	2	3	—	24
Birmingham ...	9	4	4	5	2	4	—	28
Liverpool ...	4	6	8	9	8	2	—	37
Manchester ...	8	9	6	6	1	1	—	31
Leeds ...	5	8	1	7	2	7	—	30
Sheffield ...	7	6	7	7	4	5	—	36
Bristol ...	4	6	8	3	2	4	—	27
Total ...	43	46	35	42	21	26	—	213

In recent decades London epidemics of measles have usually begun late in the fourth quarter or early in the first, have reached their peak early in the second quarter and have generally been over by the end of that quarter. Thus, when London measles deaths in 1931–38 are aggregated, the quarterly distribution in the four epidemic years and four intermediate years was:—

	4th quarter	1st quarter	2nd quarter	3rd quarter
Epidemic years ... ..	139	1,145	1,260	88
Intermediate years ... ..	13	30	44	47

During the last 20 years, until 1940, epidemics never commenced later than the first quarter, and such an event has been of rare occurrence throughout the present century. Consequently the amount of intermingling of children during the Michaelmas and Lent terms following an epidemic-free year might well be a predominant factor in determining whether an epidemic occurs or not during that year in London. Never since 1917 had there been a break in the biennial

periodicity of epidemics, but in the first quarter of 1940, when one was expected to begin, it failed to appear. It is difficult to escape the conclusion that this was connected with the great and unprecedented reduction of school contact between the children living in London from September 1939 to Easter 1940 and after, as will be seen later.

It has been objected, however, that since in 1940 an expected epidemic in New York was also 3 quarters late in appearing, there must have been some world-wide influence at work, and that what happened in some English cities was not due to dispersal and school closure, but to some failure of the virus. An examination of the periodicities over the last 30 years has, therefore, been made in the next table, where are set out the numbers of measles deaths in twelve-month periods October to September from 1910-11 to 1939-40 in the six largest English cities and the numbers of reported cases in New York in the calendar years 1911-40.

Period Oct.-Sept.	London A.C. (deaths)	Birming- ham (deaths)	Liverpool (deaths)	Manchester (deaths)	Leeds (deaths)	Sheffield (deaths)	New York* (cases, in hundreds)
1910-11	3,274	328	359 (311) *	376	149	861	255
1911-12	1,151	124	589 (864) *	482	133	30	390
1912-13	2,306	826	607 (319) *	291	138	453	293
1913-14	958	174	350 (521) *	231	151	395	258
1914-15	2,676	555	440 (255) *	492	115	645	382
1915-16	712	87	236	175	174	216	216
1916-17	1,819	356	423	315	183	157	275
1917-18	1,935	47	409	125	493	27	287
1918-19	303	189	61	106	22	196	82
1919-20	1,113	81	462	251	183	64	351
1920-21	157	225	111	2	7	87	77
1921-22	1,656	62	369	326	25	160	406
1922-23	154	194	279	107	175	9	140
1923-24	1,539	71	203	376	41	114	336
1924-25	117	104	412	56	39	15	95
1925-26	1,170	62	184	236	12	87	397
1926-27	53	146	342	18	122	5	21
1927-28	1,480	32	138	270	15	138	350
1928-29	112	194	451	29	107	8	25
1929-30	1,113	25	96	175	1	69	236
1930-31	56	199	451	18	47	6	265
1931-32	885	22	287	172	57	44	104
1932-33	62	110	292	9	7	1	362
1933-34	906	25	246	133	103	25	50
1934-35	10	49	78	9	3	11	285
1935-36	596	35	248	204	50	54	365
1936-37	15	74	2	8	8	3	121
1937-38	245	7	224	96	19	26	346
1938-39	2	17	3	1	3	3	37
1939-40	5 (29) *	2 (10) *	31 (136) *	19 (28)	5 (8) *	3 (9) *	105

\* Calendar year totals, also given (in brackets) for Liverpool in 1911-15 and all towns in 1940, when epidemics tended to commence in the second or third quarters.

London epidemics occurred in odd years from 1911 to 1917, changing to even years from 1918 to 1938. In Manchester epidemics occurred in 1915 and 1917, followed by two successive years of low death rate, after which they occurred in the even years in step with London. If hypothetical cosmic factors influence periodicity in particular years, they must have been remarkably



dormant during the twenty years 1919–38, for throughout that time, whilst London and Manchester had epidemics in every even year, Birmingham, situated half-way between, maintained an opposite periodicity. Leeds was also out of step with Sheffield in the same county from 1922 to 1931. In 1921–22 Leeds experienced two successive years with few deaths, but London, Manchester, Liverpool and Sheffield did not follow suit. Other instances of two successive years of low death rate occurred in Manchester, 1918–19, and in Sheffield, 1920–21, but in neither case did any of the other towns show the same phenomenon, and the lapse must be attributed to some local cause. The table does not, in fact, suggest any definite tendency for changes in periodicity to occur simultaneously in the six towns prior to 1940.

Before proceeding to examine the evidence that the periodicity of measles was temporarily affected in certain areas by the dispersal movements of children and by long-continued school closure consequent upon the present war, some reference must be made to Brownlee's well-known work on measles periodicity. By means of periodogram analysis of the London deaths in 1838–1913 he found that periods of 87, 89½, 97, 105, 106, 109½ and 114 weeks were revealed, of which the 97-week period was much the most prominent. In Glasgow he found evidence of periods of 98 and 109 weeks, and in Sheffield 96 and 104. The predominance of these intervals over other intervals during 1838–1913 as a whole must be accepted as mathematical facts, but it need not follow that they represented anything inherent in the life-cycle of the infecting agent, for this was not a controlled laboratory experiment from which the principal disturbing factors had been removed. Important changes took place during the 76 years not only in the population of children and in their environment, but apparently also in the fundamental relations between season and measles mortality, all of which must have had complex and incalculable disturbing effects on the smoothness of periodogram frequencies and upon assumptions as to the significance of variations in those frequencies. During the latter half of the period the birth-rate began to fall, thereby reducing the proportion of children under 4 years of age who are responsible for the bulk of the deaths (88 per cent. in 1881–90, 83 per cent. in 1921–30) to the children of 4 and over (who represent half or more of the notified cases). Furthermore, Education Acts came into force about the middle of the period, which must have affected the amount of intermingling of children of infant school ages very considerably. Then, as was indicated in the earlier tables of this paper, a profound and progressive change set in after 1881–90 in the seasonal distribution of measles deaths, which can be seen perhaps more clearly from the following ratios between the average quarterly deaths in successive decades:—

	1881–90	1891–1900	1901–10	1911–20	1921–30
1st/4th quarter ... ..	0·91	1·30	1·35	2·64	4·45
2nd/1st „ ... ..	1·45	1·39	1·18	0·86	0·72
3rd/2nd „ ... ..	0·60	0·47	0·47	0·36	0·14

Accompanying this change, and probably arising from the same causes, whatever they were—I suggest the combined effects of the Public Health and Education Acts—the regularity of the periodicity underwent curious changes. In 1871–80 there were three years with unusually high mortality. In 1881–90

periodicity became obscure, and the week with the highest total deaths in the decennium was the 21st, at the end of May. In 1891-1900 there appeared a regular recurrence of epidemics in the even years, with maxima at the 18th, 20th, 17th, 12th, and 18th weeks. In 1901-10 periodicity was again obscure, but in 1911-20 it became more definite, the maxima ranging from the 11th to 15th weeks, and this continued until 1938, with maxima close to the 13th week. Thus between 1895 and 1910 the week with maximal deaths moved back from about the 20th to about the 13th, where it has since remained, but I know of no evidence that this change in the location of the peak of deaths on the seasonal scale was cyclical.

Another element likely to disturb the smoothness of periodogram frequencies was the Easter school holiday between the 12th and 18th weeks, for this tends, as will be shown later, to reduce the incidence of fresh cases, and probably affects the curve of deaths to some extent. In the presence of these irreversible changes during part of the period of study, I do not think that it is justifiable to draw conclusions about natural cyclical periods from periodogram analysis.

(2) *Incidence measured by Notification in all areas grouped according to the Dispersal of School Children (November 1939 to June 1941)*

Let  $r$  = quarterly notification rate per 10,000 children under 15 years of age in England and Wales.

$r'$  = quarterly notification rate per 10,000 persons aged 15 and over in England and Wales.

$P_0$  = population of an area at all ages before the dispersal of children, including  $p_0$  at ages under 15.

$P$  = mean civilian population of the area at all ages after the dispersal, including  $p$  at ages under 15.

$M$  = number of notifications of civilians in the area during the quarter.

As was stated in the previous paper dealing with diphtheria and scarlet fever, the ratio  $p_0/P_0$  may be regarded as constant in large groups of areas, viz.  $P_0 = \frac{14}{3} p_0$ . For measles 39/40 of the notifications may be estimated as occurring in  $p_0$  and 1/40 in  $P_0 - p_0$ ,\* so:—

$$p_0 r = 39(P_0 - p_0)r' = 39\left(\frac{14}{3} - 1\right)p_0 r' = 143p_0 r', \text{ whence } r = 143r'.$$

By the same reasoning as for diphtheria and scarlet fever, it follows that the quarterly rates of *measles* incidence per 10,000 children under 15, corrected for changes in the age constitution of the population produced by dispersal movements, are:—

$$\text{In quarters before the dispersal} \quad \cdot \quad \frac{3.9 \times 10^4 M}{p_0}$$

$$\text{In quarters after the dispersal} \quad \cdot \quad \frac{(4 \times 143)10^4 M}{(143 - 1)p + P} = \frac{4.03 \times 10^4 M}{p + P/142} \dagger$$

\* In St. Pancras 1924-27, of 6,605 notified cases, 6,438 were children under 15 (*Annals of Eugenics*, 1928, III, 367).

† If  $D$  = population of civilians at all ages in the quarter—population as enumerated in National Register, September 29, 1939.

$D_0$  = pre-dispersal population—National Register population

$P = P_0 - D_0 + D = \frac{14p_0}{3} - (D_0 - D)$ , whence  $\frac{P}{142} = \frac{p_0}{30} - \frac{D_0 - D}{142}$ .

For *whooping cough* it can be assumed that all the notifications were of children under 15,\* and the corresponding rates are:—

$$\text{In quarters before the dispersal} \quad . \quad \frac{4 \times 10^4 M}{p_0}$$

$$\text{In quarters after the dispersal} \quad . \quad \frac{4 \times 10^4 M}{p}$$

Rates of incidence before the dispersal cannot be obtained, since for these two diseases compulsory notification over the whole of England and Wales did not become fully operative until November 1939. Rates have been calculated for the regional belts in the last seven weeks of 1939,† and for all groups of areas used in this paper in the four quarters of 1940. For the first two quarters of 1941 the numbers of civilian notifications, *M*, are given, but no rates have been calculated, owing to the difficulties of estimating the population movements of children after the autumn of 1940.

The notation used for the areal grouping is as follows:—

*E* = evacuation area, according to the original schedule.

*N* = neutral area (or area scheduled for reception to which no school children were sent in 1939).

*R* = reception area, classified according to the estimated percentage addition of billeted schoolchildren to resident children at end of September 1939 (*e.g.*, *R*<sub>10</sub>—indicates areas where this increase was 10 but less than 20 per cent.).

*L* = London administrative county.

*l* = London's outer ring.

*s* = rest of South-East and South-West regions.

*m* = Midland, East and Welsh regions.

*n* = North region.

*a* = Great town (*i.e.*, county borough or town of 50,000 population and over).

*b* = Small town (*i.e.*, with population of 25,000 and over not included in (*a*)).

*c* = other urban area (*i.e.*, with population under 25,000).

*d* = rural district.

For further details reference should be made to the previous paper.

*National and regional incidence.*—The rates of notification per annum per 10,000 children under 15 in England and Wales since notification was introduced are estimated to have been as follows:—

	1939 Last 7 weeks	1940				1941			
		1st quarter	2nd quarter	3rd quarter	4th quarter	1st quarter	2nd quarter	3rd quarter	4th quarter
Measles ...	120	221	387	470	754	923	727	150	47
Whooping cough ...	63	34	38	58	117	208	261	215	121

\* In Greenwich, Battersea, Wandsworth and Holborn, of 15,283 notified cases 15,169 were children under 15, or 99.3 per cent. (*Lancet*, 1933, Jan. 28th, p. 213).

† Substituting 7.48 for 4.03 in the measles formula and 7.43 for 4 in the whooping-cough formula.

Measles incidence increased steadily during 1940, reaching its peak in the first quarter of 1941, when 205,184 cases of all ages were notified; it then declined until the fourth quarter, when only 10,366 in all were notified. Whooping-cough incidence began to increase in the third quarter of 1940, and reached its peak in the second quarter of 1941 with 56,170 cases notified, after which it declined.

Dividing the country into the regional groups, the estimated rates per 10,000 children under 15 up to the end of 1940 were:—

		1939 Last 7 weeks	1940			
			1st quarter	2nd quarter	3rd quarter	4th quarter
Measles	Greater London	16	88	88	184	378
	Rest of South	65	135	245	276	505
	Midlands, East, and Wales	189	265	370	462	680
	North	130	284	635	758	1,139
Whooping cough	Greater London	22	15	12	20	59
	Rest of South	65	33	43	37	65
	Midlands, East, and Wales	76	41	47	86	145
	North	66	35	36	60	152

Measles appears to have been at a very low level in London during November and December 1939; and during the first half of 1940 less than  $\frac{1}{2}$  per cent. of the resident children were reported as contracting it, the rate per annum during this period being 88 per 10,000. The rate then doubled in the third quarter, again doubled in the fourth, and again in the first quarter of 1941, reaching a maximal level of about 860 in the second quarter of 1941, after which it declined. In the rest of the South the rate increased progressively throughout 1940, being  $1\frac{1}{2}$  times that of Greater London in the first, third and fourth quarters and about 3 times in the second quarter. The other divisions also showed a progressive rise, the Northern rates being more than double those of the South throughout 1940, whilst the Midland rates were intermediate except at the end of 1939.

Whooping-cough incidence was likewise very low in Greater London until the autumn of 1940, but then rose to a maximal level about 320 by the third quarter of 1941. During the first half of 1940 the average rates in the South, Midland and Northern divisions were respectively 2.8, 3.3 and 2.6 times the London rate, and in the third quarter the ratios were 1.8, 4.3 and 3.0. In the fourth quarter of 1940 the Midland and Northern rates were nearly 3 times as great as in London and the South.

If Greater London is combined with the rest of the South, giving three belts, Southern, Midland and Northern, the bulk of the initial dispersal of children from evacuation areas was to reception areas within the same belt, and for all practical purposes these divisions can be dealt with as though self-contained. The numbers of notifications, excluding non-civilians, and the estimated quarterly rates per 10,000 children under 15 in the E, N and R areas within each of these divisions, distinguishing *a*, *b*, *c* and *d* areas, are given in the large tables.

## Measles.—Civilian Notifications, and Rates per 10,000 Children. Southern Division (including Greater London)

Groups of areas	No. of notifications (civilians).										Estimated rates per annum per 10,000 children under 15				
	1940					1941					1940				
	1939 Last 7 weeks	1st quarter	2nd quarter	3rd quarter	4th quarter	1st quarter	2nd quarter	1939 Last 7 weeks	1st quarter	2nd quarter	1st quarter	2nd quarter	3rd quarter	4th quarter	
<i>Greater London</i>															
<i>EaL</i>	76	648	438	901	3,467	4,921	4,620	15	61	38	88	113	338		
<i>EaM</i>	76	786	483	899	1,419	6,943	9,172	19	95	55	113	178			
<i>EaB</i>	6	24	25	109	469	889	1,296	9	35	20	86	368			
<i>EaI</i>	3	24	7	15	25	155	413	18	76	22	46	76			
Total evacuation	161	1,502	953	1,924	5,380	12,908	15,501	17	73	45	97	272			
<i>NaL</i>	26	273	388	1,635	3,367	3,825	2,000	13	73	104	437	900			
<i>NbL</i>	39	499	1,095	1,114	1,461	3,377	5,042	19	132	291	296	388			
<i>NcL</i>	16	401	366	811	1,094	3,227	3,271	12	117	143	316	427			
Total neutral	81	1,173	1,849	3,660	5,922	10,429	10,313	15	116	184	363	588			
Total Greater London	242	2,675	2,802	5,484	11,302	23,337	25,814	16	88	88	184	378			
<i>Rest of South</i>															
<i>Eas</i>	14	204	48	89	84	808	2,528	11	85	19	37	35			
<i>Ebs</i>	10	66	67	36	40	540	2,912	13	45	45	24	26			
<i>Ecs</i>	—	50	9	2	2	22	490	—	345	62	14	14			
Total evacuation	24	320	124	127	126	1,370	5,930	12	80	30	31	31			
<i>Nas</i>	15	176	82	679	932	1,574	657	13	85	40	365	501			
<i>Nbs</i>	18	115	94	112	132	1,675	1,552	21	88	73	102	121			
<i>Ncs</i>	29	142	440	299	985	1,473	2,037	48	95	296	222	710			
<i>Nds</i>	31	136	32	52	294	532	385	237	349	82	134	758			
Total neutral	120	569	648	1,142	2,313	4,254	4,631	42	108	123	244	493			
<i>Ras</i>	245	1,250	3,059	2,191	2,989	8,937	1,554	68	195	492	347	455			
<i>Rbs</i>	40	561	1,495	1,495	2,484	4,819	3,898	14	114	414	296	486			
<i>Rcs</i>	693	1,798	2,723	3,651	8,079	16,634	11,592	114	169	265	322	731			
<i>Rds</i>	640	2,076	3,141	5,379	9,457	24,290	18,467	65	120	186	284	499			
Total reception	1,618	5,685	10,907	12,616	22,983	54,680	35,511	73	144	285	303	611			
Total Rest of South	1,762	6,574	11,679	13,885	25,422	60,304	46,072	65	135	245	276	505			
Total Southern division	2,004	9,249	14,481	19,319	36,724	83,641	71,886	47	117	186	241	458			

Measles.—Civilian Notifications, and Rates per 10,000 Children. Midland and Northern Divisions

Groups of areas		No. of notifications (civilians).										Estimated rates per annum per 10,000 children under 15				
		1940					1941					1939 Last 7 weeks	1940			
		1st quarter	2nd quarter	3rd quarter	4th quarter		1st quarter	2nd quarter	3rd quarter	4th quarter	1st quarter		2nd quarter	3rd quarter	4th quarter	
<i>Midland belt</i>		89	589 7	2,188 22	3,562 23	4,944 220	6,103 293	8,365 408			16	56 15	205 47	333 49	462 192	
Total evacuation		89	596	2,210	3,585	5,164	6,396	8,773			15	54	198	321	462	
<i>Nam</i>		1,379	3,658	6,079	3,890	5,330	7,952	6,706			220	315	523	337	462	
<i>Nbm</i>		113	698	2,144	1,401	1,243	3,281	3,472			50	166	509	332	295	
<i>Ncm</i>		260	1,062	1,343	1,356	1,636	1,636	1,938			183	405	513	518	625	
<i>Ndm</i>		143	145	162	536	1,058	1,094	816			233	129	144	476	940	
Total neutral		1,895	5,563	9,728	7,183	9,267	14,806	12,932			179	284	497	369	476	
<i>Ram</i>		1,249	2,311	1,225	1,977	4,366	4,124	2,141			604	626	338	562	1,242	
<i>Rbm</i>		824	1,402	2,487	3,170	5,452	6,957	4,081			261	243	435	566	895	
<i>Rcm</i>		1,375	3,278	4,315	6,204	10,609	11,581	7,192			253	339	454	659	1,126	
<i>Rdm</i>		1,785	5,368	6,728	8,377	13,769	23,772	15,919			188	267	289	422	694	
Total reception		5,233	12,359	13,755	19,728	34,196	46,434	29,333			238	315	354	514	891	
Total Midland		7,217	18,518	25,693	30,496	48,627	67,636	51,038			189	265	370	462	680	
<i>North</i>																
<i>Ean</i>		542	1,444	7,116	21,277	38,034	20,882	12,245			44	60	285	860	1,537	
<i>Nbn</i>		38	127	578	959	734	599	721			63	108	486	835	639	
<i>Ecn</i>		16	261	718	444	722	731	465			40	337	917	564	918	
Total evacuation		596	1,832	8,412	22,680	39,490	22,212	13,431			45	70	218	850	1,480	
<i>Nan</i>		355	4,821	12,863	6,970	7,246	5,944	6,176			65	475	1,267	687	714	
<i>Nbm</i>		183	502	4,249	4,817	8,738	3,332	1,805			63	94	793	899	1,631	
<i>Ncn</i>		420	1,808	6,966	8,479	9,248	7,118	3,833			94	217	829	1,018	1,145	
<i>Ndn</i>		1	25	32	150	329	331	61			9	120	443	722	1,584	
Total neutral		959	7,156	24,109	20,416	25,561	16,725	11,875			74	298	1,003	849	1,063	
<i>Ran</i>		636	4,066	2,237	1,245	2,426	1,821	1,144			417	1,554	874	492	968	
<i>Rbm</i>		743	1,272	1,971	966	1,772	1,145	754			522	520	827	411	754	
<i>Rcn</i>		782	3,226	4,568	4,420	5,661	3,899	3,899			200	486	682	667	839	
<i>Rdn</i>		1,313	3,218	4,679	4,648	6,910	6,277	5,336			237	327	475	488	725	
Total reception		3,474	11,882	13,356	11,279	16,669	13,877	11,299			280	546	628	536	792	
Total North		5,029	20,870	45,877	54,375	81,720	52,814	36,605			130	284	635	758	1,139	

*Measles in evacuation, neutral and reception areas.*—The dissection of Greater London into evacuation and neutral areas was based on population density and proximity to industrial centres; the E areas comprised the whole of the administrative county and certain parts of the outer ring. There was no reason why in normal circumstances the N areas should have higher rates of measles or whooping-cough incidence amongst children under 15 than the E portion; on every basis of comparison the reverse was to be expected. The table shows, however, that in the first quarter of 1940 the neutral area rate of measles incidence was 1·6 times the evacuation area rate; in the second quarter the proportion was 4·1, in the third quarter 3·6 and in the fourth quarter 2·2.

Prior to the dispersal of school children the average number of children (aged under 15) per acre was about 6·7 in the aggregate of *ELa*, *Ela* and *Elb* areas of Greater London, compared with about 1·9 in the aggregate of *Nla* and *Nlb* areas, and at the end of 1939 the former figure had been reduced to about 4 per acre. The average density of children per acre was still about twice as great in the E areas of London as in the N areas after the dispersal, but this does not necessarily mean that the amount of contact between the children was also greater, for there was an important difference between the E and N areas in the dates of reopening of schools after their initial closure at the beginning of the war. I am indebted to the London County Council for information about school attendance in the *ELa* areas, from which it appears that of the children of school age still remaining there the estimated percentages who were receiving instruction in schools or classes were as shown below:—

	Dec. 1939	March 1940	June 1940	Dec. 1940
School, full-time ... ..	0	0	2	44
„ part-time ... ..	0	24	58	1
Home classes ... ..	0	about 46	30-40	} 55
No schooling ... ..	100	about 30	less than 10	

If  $x$  be the average number of contacts with other scholars normally experienced by a child when attending school full time, the number under conditions of part-time schooling would be about  $\frac{1}{2}x$ , and under home class instruction about  $\frac{1}{4}x$  or less. Applying these fractions to the percentages in the table above, it follows that the amount of contact with other children caused by schooling was *nil* in the last quarter of 1939, about a quarter of the normal in the first quarter of 1940, two-fifths of the normal in the second quarter and three-fifths of the normal in the third and fourth quarters. From information kindly supplied by the Education authorities of a number of boroughs in London's outer ring, it appears that in the *Ela* areas the bulk of the schools remained closed until the end of the first quarter of 1940, but in the second quarter some 90 per cent. of the children were attending school full or part time, and in the next two quarters from 50 to 80 per cent. In the *Nla* areas, however, school attendance was generally 70 to 80 per cent., in the last quarter of 1939, about 80 per cent. in the first quarter of 1940, 90 per cent. in the second and 80 per cent. in the third and fourth. The opportunities for infection at school from other children must, therefore, have been roughly in the following ratios to the normal during the five successive quarters:—

		1939	1940			
		4th quarter	1st quarter	2nd quarter	3rd quarter	4th quarter
Evacuation districts	...	0	1/4	2/5	3/5	3/5
Neutral	„	3/4	4/5	9/10	4/5	4/5

In the evacuation districts of Greater London measles incidence did not begin to rise whilst this fraction was below about three-fifths, but in the neutral districts, where the fraction probably never fell below three-quarters, incidence began to rise at least half a year earlier, in the first quarter of 1940, and reached a much higher level than in the evacuation districts. Evidence of a similar kind is obtained by a study of other towns, as shown below.

In 1940 epidemics were expected to start in or just before the first quarter in five of the evacuation towns, but the trend of the notifications (civilians only) was as follows:—

		London A.C.	Liverpool	Manchester	Leeds	Sheffield
1940.	1st quarter	648	420	226	136	111
	2nd „	438	1,153	2,261	509	99
	3rd „	901	3,773	7,049	998	1,195
	4th „	3,467	5,667	5,308	2,713	9,495
1941.	1st „	4,921	2,214	2,098	4,267	1,196
	2nd „	4,620	1,606	1,090	2,159	377

In London the epidemic began at the end of the third quarter of 1940 and reached its peak in the first quarter of 1941. In Manchester it began in the second quarter and very quickly reached its peak in the third quarter of 1940. In Liverpool it began in the second quarter and reached its peak in the fourth quarter. In Leeds incidence rose in the second quarter of 1940 and increased slowly to a peak in the first quarter of 1941. In Sheffield it did not begin to rise until the third quarter, but rapidly attained a high peak in the fourth quarter

		London A.C.	Liverpool	Manchester	Leeds	Sheffield
Per cent. at school full time	{ Dec. 1939	0	0	8	?	?
	{ Feb. 1940	0	0.3	16	73	14
	{ May 1940	2	44	82	92	81
	{ Dec. 1940	44	72	99	98	100
Per cent. at school part time	{ Dec. 1939	0	0	28	?	?
	{ Feb. 1940	24 *	0.5	33	0	19
	{ May 1940	58	26	13	0	12
	{ Dec. 1940	1	17	1	0	0
Per cent. attending home classes	{ Dec. 1939	0	64	16	?	?
	{ Feb. 1940	46	61	9	0	67
	{ May 1940	30-40	18	0.7	0	7
	{ Dec. 1940	below 30	4	0	0	0

\* March.



of 1940. Thus in London the epidemic was three or four quarters late, but in Liverpool and Sheffield the maximum was only delayed to the fourth quarter, and in Manchester to the third quarter of 1940, whilst in Leeds the rise began early, but the maximum was reached three quarters late. The sequence of epidemic commencement conforms in general with the rates of restoration of full school attendance (see preceding table).

Assuming as before that part-time school resulted in one-half and home classes in one-quarter of the normal contacts with other scholars, the opportunities for infection by that means would be reduced to about the following fractions:—

		London A.C.	Liverpool	Manchester	Leeds	Sheffield
1939.	4th quarter	...	0	1/12	1/4	?
1940.	1st "	...	1/4	1/3	3/4	2/5
	2nd "	...	2/5	9/10	9/10	9/10
	4th "	...	3/5	4/5	1	1

On this basis of estimation, epidemics did not begin until the fraction had reached at least  $\frac{3}{8}$ , and they attained a greater size relative to the populations in the towns where the return towards normal school attendance was sudden and rapid, as in Manchester and Sheffield.

Comparison of measles incidence rates in the Greater London evacuation areas in the aggregate (*EL* and *EI*), the neutral part of the outer ring (*NI*) and other great towns in the South which were neutral (*Nas*) or reception (*Ras*) areas in the four quarters of 1940, and a similar comparison of rates in the Northern Great towns classed as evacuation (*Ean*), neutral (*Nan*) and reception (*Ran*) areas, leads to much the same conclusion, the rates per 10,000 children at ages under 15 being as follows:—

Quarter of 1940 .			Greater London and Southern Great towns				Northern Great towns		
			<i>EL, EI</i>	<i>NI</i>	<i>Nas</i>	<i>Ras</i>	<i>Ean</i>	<i>Nan</i>	<i>Ran</i>
1st	...	...	73	116	85	195	60	475	1,554
2nd	...	...	45	184	40	492	285	1,267	874
3rd	...	...	97	353	365	347	860	687	492
4th	...	...	272	588	501	455	1,537	714	958

In the South the *NI* areas, as already noted, had higher rates than the evacuation areas of Greater London in each quarter, but in the reception towns incidence reached its maximum half a year earlier than in the neutral groups (*NI* and *Nas*) and the successive *R/E* ratios in the four quarters were 2·7, 10·9, 3·6, 1·7. In the Northern Great towns incidence in the *E* group increased throughout 1940 from an epidemic-free level of 60 in the first quarter to 1,537 in the fourth, whereas in the *R* group it rose (from 417 in December 1939) to 1,554 in the first quarter, 26 times the *E* rate, declining to 492 by the third quarter and then rising again. In the *N* group the first quarter's rate was intermediate between the *E* and *R* rates, but the peak rate of 1,267 was reached a quarter later than in the *R* towns, but two quarters earlier than in the *E* towns.

In the Midland belt the county boroughs, distinguishing those of the Birming-

ham area, including Coventry, registered the following numbers of measles deaths in the six years 1935-40:—

Year				Birmingham area		Remainder of Midland belt		
				E	N	E	N	R
1935	...	...	...	90	24	23	97	3
1936	...	...	...	51	3	38	114	16
1937	...	...	...	107	24	29	55	10
1938	...	...	...	15	2	15	51	2
1939	...	...	...	39	9	1	36	2
1940	...	...	...	13	2	14	31	13

Epidemics in the Birmingham area were occurring in the odd years, and none was to be expected in 1940, and the aggregate of the remaining towns showed no periodicity. The quarterly notification rates per 10,000 children in the Great towns of the Midland belt as a whole in the four quarters of 1940 were:—*Eam*: 56, 205, 333, 462; *Nam*: 315, 523, 337, 462; *Ram*: 626, 338, 562, 1,242. Expressed in terms of the N group the E rates were: 0·18, 0·39, 0·99, 1·00 and the R rates 1·99, 0·65, 1·96, 2·65. The school attendance percentages in the largest city of the E group were, in the first quarter 34 per cent. attending school full time, 12 per cent. part time and 33 per cent. at home classes, equivalent on the previous basis of estimation to about half the normal amount of school contact, and in the second quarter they were 92 per cent. full time, 5 per cent. half time and 1 per cent. home classes, equivalent to about 95 per cent. of the normal. No cosmic influence can be postulated here to explain the low E/N ratios in the first two quarters, and the obvious explanation lies in the greatly reduced opportunities for infection in the E group during the first quarter.

In England and Wales as a whole, estimates which the Board of Education has kindly furnished lead to the following percentage distribution of the children in the three groups of areas during the first two quarters of 1940:—

	Evacuation areas		Neutral areas		Reception areas	
	1st quarter	2nd quarter	1st quarter	2nd quarter	1st quarter	2nd quarter
School, full time ...	10	40	75	near 100	near 100	near 100
„ part time ...	40	40	23	—	—	—
Home classes ...	22	10	—	—	—	—
No schooling ...	28	10	2	—	—	—

From these figures the daily amount of contact with other scholars may be estimated in the first quarter as about  $\frac{1}{3}$  normal for the E areas generally, 85 per cent. of normal for the N areas and above the normal for the R areas; and in the second quarter as about  $\frac{2}{3}$  normal, normal and above normal respectively. Lower rates of incidence might consequently be expected in neutral than in reception areas in the first quarter, and still lower rates in evacuation areas during the first two or three quarters of 1940. The measles rates for the large towns fulfil this expectation, not only in the southern and northern areas where epidemics were expected, but in the Midland belt also.

In New York there was no dispersal of children and no school closure, but nevertheless in 1940 the epidemic was three-quarters late in starting. The reported cases in hundreds in each quarter from 1934 onwards were:—

Year				1st quarter	2nd quarter	3rd quarter	4th quarter
1934	...	...	...	7	34	6	3
1935	...	...	...	64	187	24	9
1936	...	...	...	123	221	18	4
1937	...	...	...	19	88	11	3
1938	...	...	...	84	245	15	3
1939	...	...	...	8	22	4	2
1940	...	...	...	6	38	17	44
1941	...	...	...	444	349	6	2

Instead of starting in the first quarter of 1940 and reaching its maximum in the second, as in 1936 and 1938, the epidemic began in the fourth quarter and attained an exceptionally high peak in the first quarter of 1941. But, even over the short period of years shown above, the quarterly totals do not show a constant periodicity. The calendar year totals given in the large table with the deaths in the English cities, showed no periodicity between 1911 and 1918; epidemics then occurred in the even years to 1930, in the odd years from 1931 to 1935 and again in the even years 1936 and 1938. The breaks in periodicity in 1931 and 1936 were not reflected in any of the six large English cities, and the fact that another break occurred in 1940, just when unprecedented disturbances of the normal life of children were taking place in the English towns, should, I think, be attributed to coincidence and nothing more. Such a conclusion seems, on weighing the evidence, more reasonable than the necessary alternative one, which would be that: (1) the measles virus was simultaneously debilitated at the beginning of 1940 in New York and the largest towns of England, (2) it was not so affected in the towns of the north of England used as reception areas, and (3) the correlation between the timing of the subsequent epidemics and the reopening of schools was a mere accident.

It is worth while at this point to see whether the weekly notifications of measles are affected by school closure during short holiday periods occurring in the midst of epidemics. For this purpose the weekly figures for England and Wales, including and excluding the seven largest cities, are shown below for the fortnight of which Easter Sunday was the centre, the four weeks preceding and the six weeks following, in 1940 and 1941. Although the Easter holiday was more variable in length than in normal times, there was in most areas a short period of school closure around the Easter week-end, and if school attendance is important in the spread of infection, it would be expected, in view of the incubation period of measles, that the week commencing a fortnight after Easter Sunday would register a drop in new cases, followed by a return to about the original level in the course of the next two or three weeks. The totals exclusive of the large cities are given also because at Easter 1940 arrangements for school reopening were still incomplete, whilst in 1941 the period studied was one in which there was in those areas considerable disturbance of school attendance due to air raids. In 1940 Easter Sunday fell on March 24th and in 1941 on April 13th.

1940			1941		
Week ending	No. of measles notifications		Week ending	No. of measles notifications	
	Total	Except seven cities		Total	Except seven cities
Feb. 24th ...	4,793	4,538	March 15th ...	15,056	13,859
March 2nd ...	4,535	4,325	" 22nd ...	14,888	13,512
" 9th ...	4,888 ( Mean	4,662 ( Mean	" 29th ...	14,589 ( Mean	13,293 ( Mean
" 16th ...	4,332 / 4,610	4,110 / 4,386	April 5th ...	15,971 / 15,280	14,290 / 13,792
March 23rd ...	4,111 ( Mean	3,925 ( Mean	April 12th ...	13,030 ( Mean	11,630 ( Mean
" 30th ...	4,750 / 4,430	4,590 / 4,212	" 19th ...	13,951 / 13,490	12,412 / 12,021
April 6th ...	4,069	3,840	April 26th ...	13,883	12,205
" 13th ...	3,592	3,432	May 3rd ...	11,004	9,569
" 20th ...	4,013	3,899	" 10th ...	11,993	10,471
" 27th ...	4,586	4,364	" 17th ...	11,909	10,588
May 4th ...	5,286	5,034	" 24th ...	13,400	12,050
" 11th ...	6,223	5,955	" 31st ...	13,031	11,777

The number of notifications is diminished in the week preceding Easter and enhanced in Easter week by delays resulting from the holiday and the arithmetic mean of the two weeks is given, therefore, in the table. Expressing the notifications in the six weeks following the holiday period as percentages of the average in the two weeks preceding it, using the figures excluding the cities, the sequence is:—

1940—88, 78, 89, 99, 115, 136.

1941—88, 69, 76, 77, 87, 85.

In each year there was 12 per cent. lower incidence in the week following the holiday period; and in the week commencing a fortnight after Easter Sunday the rate had fallen by 22 per cent. in 1940 (when the measles curve was rising) and by 31 per cent. in 1941 (when the curve was falling). In the next week it increased again. The complete national totals of notifications fell by 22 per cent. in 1940, and by 28 per cent. in 1941, in the week separated from the holiday period by the average incubation period. Since even a short school holiday has such an effect upon measles incidence, it seems likely that prolonged school closure starting at the beginning of the year might have the effect of postponing an epidemic altogether until the following winter.

In the groups of "b" towns of medium population in the three divisions outside Greater London the intermingling of school children must have been above normal in the reception areas of each division throughout the year, but subnormal in the neutral and evacuation areas of each division in the first quarter and in the Southern evacuation areas during most of the year. The measles rates per 10,000 children are shown below.

Quarter of 1940	South			Midland			North		
	E	N	R	E	N	R	E	N	R
1st ...	45	88	114	15	166	243	108	94	520
2nd ...	45	72	414	47	509	435	486	793	827
3rd ...	24	102	296	49	332	566	835	899	411
4th ...	26	121	486	192	295	895	639	1,631	754

In the South the average rates of prevalence became high only in the reception areas, but in the Midland belt the neutral towns also registered a sudden rise in the second quarter, and in the North this occurred both in evacuation and neutral towns. These contrasts are again consistent with the hypothesis that contact between children at school is one of the chief factors in determining the rise and fall of measles incidence.

In the next table the reception areas, urban and rural, are grouped according to the proportions of visitor to native children after the initial dispersal of September 1939, and the last three columns show the measles rates in successive periods of 1940 for each group. The neutral towns outside Greater London are also given for comparison.

Type of area	Per cent. increase in child population	No. of civilian notifications of measles in each quarter						Rate per 10,000 chil- dren (per annum)		
		1940				1941		1940		
		1st	2nd	3rd	4th	1st	2nd	1st	2nd	3rd-4th
Reception towns (Ra, Rb, Rc)	Under 10 *	2,932	5,804	5,544	11,851	15,673	8,563	253	416	750
	10-	4,007	3,741	1,982	4,067	6,641	3,561	690	653	513
	20-	3,380	3,414	5,436	5,215	9,589	5,549	402	414	824
	30-	2,049	3,251	2,562	6,236	7,397	4,462	314	512	679
	40-	1,185	2,467	2,847	3,274	8,541	5,501	202	431	520
	50-	3,639	4,881	6,037	11,006	9,664	6,581	300	420	725
	100 and over	2,072	1,022	811	2,063	3,147	2,204	767	395	566
	Total	19,264	24,570	25,210	43,712	60,652	36,421	363	474	653
Neutral towns †	Total	12,982	34,199	28,003	35,460	33,828	28,176	275	725	683
Rural reception areas (Rd)	Under 10 *	1,836	3,443	4,308	7,896	11,821	7,666	203	381	653
	10-	3,088	3,105	4,295	6,820	10,805	5,937	335	341	590
	20-	1,545	1,523	2,864	4,428	8,887	7,264	225	226	501
	30-	1,186	1,696	2,215	3,934	9,839	7,168	153	224	390
	40-	856	1,122	1,792	2,445	4,484	4,396	163	220	395
	50-	2,122	2,487	2,648	4,177	7,275	6,755	246	300	391
	100 and over	29	72	282	436	1,278	536	54	142	730
	Total	10,662	13,448	18,404	30,136	54,339	39,722	225	290	502

\* Areas scheduled for reception which received no children in 1939 are included with the neutral areas.

† Excluding neutral parts of Greater London.

In the first quarter of 1940 both in the urban and rural reception areas the measles rate was low where the visitor children numbered less than 10 per cent. of the native children, but was very high in the group where the proportion was 10-20 per cent., and then declined as the proportion increased to 40-50 per cent., rising again for higher proportions. Towards the end of the year the rates rose to high levels in the groups of areas which initially received less than 10 per cent.; and in the groups with larger proportions of visitor children the urban rates tended towards uniformity, though the rural rates showed a progressive decline as the proportion of visitor children increased up to 40 per cent. Remembering that the visitor children were mostly of school age and came from towns where larger proportions of children tend to have had measles in early life, and that the rates measure incidence in the mixed population of native and visitor children, some decrease in rate with rising proportion of visitors would be expected, and the figures in general show this. The initially low rates in the

areas with less than 10 per cent. of visitors at the first dispersal may have been due to the influx being too small in many areas to bring about any rise in measles prevalence; and the subsequent rise in incidence may have resulted from a tendency to select areas of this group for subsequent drafts of children when the second large-scale evacuation occurred in the summer of 1940. The exceptionally high rates in the first part of 1940 for the group with 10-20 per cent. of visitors may have arisen from more intimate mixing with the native children where the proportion was small than where it was large.

On this point Mr. Laskey of the Board of Education has kindly supplied the following comment:—"The original evacuation in 1939 was organized on the basis of school parties, each under its own teachers, the intention being that each party should remain in the charge of the teaching staff who came with them and retain their identity as separate schools in the reception area. The extent to which this led to their segregation from the native children depended on the actual arrangements made in each particular place. In some schools there was sufficient accommodation to allow the local and evacuee children to share the buildings simultaneously, each having their own set of rooms. More often outside accommodation, such as village halls, had to be hired to supplement the existing accommodation, in which case one school might use the school buildings and the other the hired accommodation, or alternatively (and this was frequently done) the two schools might use each building in turn, so that one school should not be entirely relegated all the time to the hired premises. In other cases resort had to be made to double shifts, whereby each school used the school buildings for half the day alternately. Each and all of these variations were liable to occur in any single Local Education Authority's area, particularly in the case of County areas.

"I do not think there was much intimate mixing of the officially evacuated children in schools in the early days, though the evacuees would, of course, mix with the local children outside. Even in the areas where the proportion of evacuee children was small compared with the native children, the evacuees would not necessarily be spread over all the schools, but would use only such of them as were necessary to take the school groups sent to the area. The position was, however, always very fluid, because children started to drift back to the evacuation areas almost at once, and this movement gathered momentum as time went on. This ultimately led to some groups becoming so small that it was uneconomic to continue the remnants as separate schools, and merging with the local schools then started, the children then being intimately mixed up. This was, however, a very gradual process. . . .

"The billeting arrangements for unaccompanied children have been based almost entirely on private households. Hostels have been provided in some places for groups of older pupils from Secondary, Junior Technical and Central Schools, but the number of these is very small and not likely to have any particular influence on the problem."

The above comments refer only to the children who were moved to reception areas in official parties; most of those who moved to such areas privately must have found their way into the local schools and come into intimate contact there with the native children, no matter what the relative numbers were.

*Whooping cough in evacuation, neutral and reception areas.*—The table shows



## Whooping Cough.—Civilian Notifications, and Rates per 10,000 Children. Midland and Northern Divisions

Groups of areas	No. of notifications (civilians)					Estimated annual rates per 10,000 children under 15					
	1940				1941		1940				
	1939 Last 7 weeks	1st quarter	2nd quarter	3rd quarter	4th quarter	1st quarter	2nd quarter	1st quarter	2nd quarter	3rd quarter	4th quarter
<i>Midland belt</i>											
<i>Eam</i>	265	284	510	1,971	3,298	3,046	2,265	49	28	189	307
<i>Ebm</i>	8	5	37	2	121	113	143	33	11	4	26
Total evacuation	273	289	547	1,973	3,329	3,159	2,408	48	25	181	305
<i>Nam</i>	274	376	374	781	1,378	2,221	2,120	44	33	69	123
<i>Nbm</i>	47	58	77	174	653	991	822	21	14	19	159
<i>Ncm</i>	66	86	208	319	579	507	611	48	34	123	226
<i>Ndm</i>	110	63	54	65	56	117	131	184	57	49	51
Total neutral	497	583	713	1,339	2,666	3,866	3,684	48	35	70	140
<i>Ram</i>	105	117	222	297	344	763	901	52	32	86	100
<i>Rbm</i>	522	431	212	519	756	1,176	1,071	169	77	36	95
<i>Rcm</i>	489	558	603	681	902	1,768	2,307	92	59	65	74
<i>Rdm</i>	941	812	876	1,014	1,718	2,953	4,025	85	41	45	52
Total reception	2,057	1,918	1,913	2,511	3,760	6,660	8,307	96	50	51	67
Total Midland	2,827	2,790	3,173	5,823	9,755	13,685	14,399	76	41	47	86
<i>North</i>											
<i>Ean</i>	395	456	454	954	3,154	7,449	8,659	34	19	40	131
<i>Ebn</i>	49	24	28	24	112	378	566	75	21	21	99
<i>Ecn</i>	7	7	11	45	208	237	223	18	9	59	271
Total evacuation	451	487	493	1,023	3,474	8,064	9,448	35	19	39	134
<i>Nan</i>	298	402	626	847	2,139	3,683	2,356	56	41	86	216
<i>Nbn</i>	195	248	230	297	1,856	1,771	1,155	69	47	57	153
<i>Ncn</i>	187	252	438	580	1,168	2,419	2,528	43	29	54	144
<i>Ndn</i>	6	1	4	11	12	48	53	55	5	20	34
Total neutral	686	883	1,298	1,835	4,127	8,006	6,688	54	38	78	176
<i>Ran</i>	108	92	136	475	1,073	1,112	761	72	36	192	433
<i>Rbn</i>	229	288	130	166	317	567	636	164	54	72	151
<i>Rcn</i>	357	358	273	425	921	1,348	1,663	88	53	42	142
<i>Rdn</i>	639	338	242	245	686	1,453	2,590	121	35	26	74
Total reception	1,333	1,076	783	1,321	3,027	4,680	5,280	110	50	64	147
Total North	2,470	2,446	2,574	4,179	10,628	20,730	21,416	66	35	69	152



that in Greater London the rate of whooping-cough incidence was higher in the industrial areas scheduled for evacuation than in the neutral areas up to the end of the first quarter of 1940. In the second quarter they were about equal, but incidence then rose less rapidly in the evacuation than in the neutral districts, the ratio falling to about 0.3 by the end of 1940. In the rest of the South the evacuation area rate was about half that of the neutral areas in the first quarter of 1940, falling below one-seventh by the third quarter. In the North, also, incidence in the evacuation areas was half that of the neutral areas at the beginning of 1940, and remained at a lower level throughout 1940. It appears from this that the dispersal of children had the effect in these regions of keeping down the whooping-cough rate in the evacuation towns. In the Midland belt, however, although the evacuation areas had a lower rate than the neutral areas in the first quarter of 1940, the position was quickly reversed as general prevalence of the disease increased.

In the Southern reception areas the whooping-cough rate was twice as high as in the neutral areas during the first half of 1940, but by the end of the year they became equalized, the ratio becoming higher again in the second quarter of 1941. In the Midland belt the reception area rate was about 1.4 times that of the neutral areas during the first half of 1940, but the ratio fell below unity by the end of the year, and then increased again. In the North the reception areas had a higher incidence than the neutral areas up to the end of the first quarter of 1940, but thereafter it fell below. It is a clear that during the first six months following the dispersal of September 1939 whooping-cough incidence was highest in the reception areas and lowest in the evacuation towns, with the neutral areas intermediate, but as prevalence rose throughout the country this phenomenon did not persist. It is none the less remarkable that throughout the first autumn and winter of dispersal children in the reception areas suffered a higher rate of attack, as indicated by notification, than did children in other parts of the country. This was true even in the rural reception areas as the following comparison shows.

	Rates per 10,000 children in the population (per annum)						
	Greater London	Evacuation Great towns			Rural reception areas		
		South	Midland	North	South	Midland	North
Nov.-Dec. 1939...	22	29	49	34	70	85	121
Jan.-March 1940...	15	9	28	19	30	41	35
April-June „ ...	12	10	49	19	42	45	26
July-Sept. „ ...	20	6	189	40	27	52	26
Oct.-Dec. „ ...	59	23	307	131	52	89	74

In the next table the reception areas, urban and rural, are grouped according to the proportionate increase in the child population at ages under 15 which resulted from the initial dispersal.

The rates of incidence of whooping cough in the estimated total populations of children under 15 do not seem to show any consistent correlation with the proportions of visitor to native children.

Type of area	Per cent. increase in child population	No. of civilian notifications of whooping cough in each quarter						Rate per 10,000 children (per annum)	
		1940				1941		1940	
		1st	2nd	3rd	4th	1st	2nd	Jan.-June	July-Dec.
Reception towns (Ra, Rb, Rc)	Under 10 *	615	434	825	1,233	2,380	2,692	47	91
	10-	313	310	280	479	856	1,581	55	66
	20-	582	731	543	859	1,772	2,032	80	84
	30-	411	426	476	971	1,614	1,523	66	114
	40-	222	168	383	553	971	1,484	34	81
	50-	510	516	653	1,565	2,560	3,148	45	96
	100 and over	94	158	530	539	603	557	49	211
	Total	2,777	2,743	3,690	6,199	10,756	13,017	54	96
Neutral towns †	Total	1,488	2,048	3,247	7,028	12,264	10,889	38	113
Rural reception areas (Rd)	Under 10 *	352	363	168	362	1,208	2,030	40	29
	10-	463	306	390	645	1,249	2,192	43	56
	20-	247	179	196	517	986	2,026	32	51
	30-	186	239	314	673	1,308	1,682	28	64
	40-	152	333	378	476	589	961	48	81
	50-	245	370	287	657	1,231	1,816	37	55
	100 and over	20	16	30	41	70	99	35	72
	Total	1,665	1,806	1,763	3,371	6,641	10,806	38	51

\* † See notes under corresponding table for measles.

### Appendix on Diphtheria in Reception Areas

In the discussion following the earlier paper dealing with diphtheria and scarlet fever during the dispersal of children in 1939-40, the question was raised as to whether the conclusion indirectly reached that most of the transient increase in diphtheria in the reception areas must have occurred amongst the native children was correct, and it was suggested that this might be confirmed by obtaining detailed information from a few areas. Another point of interest which arose was whether in areas which received a second influx of children in the summer of 1940 the incidence of diphtheria was again increased, even though the children came from the same towns as before.

Dr. R. H. Hutchinson of the Ministry of Health kindly obtained details from seven reception areas, and these were worked out by Lieut.-Colonel C. Maddock (I.M.S.). In five of the areas (A) the children who were drafted in about the middle of 1940 and later came from the same town as those who arrived in 1939, whilst in the other two (B) the drafts came from different towns. It is evident that in both groups of areas the initial increase in diphtheria affected the native children only, and in the A areas, where subsequent drafts of children came from the same town as before, the visitor children remained almost free from diphtheria up to mid-1941. In one of these areas with about 8,800 native children diphtheria was very prevalent in the first 9 months of 1939, 157 cases being notified. A small draft of children came during September, the number billeted in October being 73, and 344 cases of diphtheria occurred in the next 9 months, all amongst native children. Larger drafts of children then followed, totalling about 1,200, from the same evacuation area, and from mid-1940 to mid-1941 there were 297 cases, but again none of the billeted children was attacked. In the B areas, where the subsequent drafts came from localities different from the first, the visitor children suffered between January 1940

	A areas		B areas	
	Native children	Billeted children	Native children	Billeted children
Estimated predispersal population under 15 ... ..	28,000		11,600	
Nos. of billeted children:				
Oct. 1939 ... ..		1,615		67
Aug. 1940 ... ..		2,767		2,582
Sept. 1941 ... ..		3,926		1,808
No. of diphtheria notifications:				
Jan.-Sept. 1939 ... ..	162	—	56 *	—
Oct.-Dec. 1939 ... ..	206	0	81	0
Year 1940 ... ..	449	3	242	18
Jan.-June 1941 ... ..	88	1	45	19
Estimated annual rates per 1,000:				
Jan.-Dec. 1939 ... ..	.8	—	6	—
Oct.-Dec. 1939 ... ..	26	0	28	0
Year 1940 ... ..	16	1	21	14
Jan.-June 1941 ... ..	6	1	8	21

\* Including some adults.

and June 1941 about the same average rate of diphtheria incidence as the native children, and this may have been due to the later drafts coming from coastal towns, where the children had acquired no more immunity to the disease than those of the reception areas to which they were sent. The investigation of this small sample of reception areas confirms the view that the transient increase of diphtheria which followed the transfer of children from large cities to reception areas occurred amongst the native children, and it also suggests that the reaction to subsequent drafts coming from the same city tended to be less pronounced (as shown by the falling rates 26, 16 and 6 per 1,000 amongst the native children).

#### DISCUSSION ON DR. STOCKS'S PAPER

PROFESSOR GREENWOOD: For Dr. Stocks's paper as a whole I have nothing but praise. It is inevitably hard reading, and fully to profit from it one must do some work on the data. It is a worthy addition to the study of diphtheria and scarlet fever we already owe to the author. I am not, however, satisfied that Dr. Stocks's summary of Brownlee's researches is adequate. Whenever a writer talks about "mathematical facts," memories of forty years ago recur, when some such stick was used to beat biometric dogs, and Dr. Stocks can hardly suppose that Brownlee, who directed a hospital for infectious diseases in a great city for many years, was not aware of the "important changes" which have taken place during the last 76 years in the population of children, their environment, etc. Perhaps Brownlee's work is not quite so well known as Dr. Stocks implies, and I may not be solitary in finding it difficult to read. I will *try* to summarize it a little more sympathetically than Dr. Stocks.

Nothing will be lost by confining myself to the two papers published in the *Philosophical Transactions*,\* and to those sections which relate to London experience since 1838, in the second paper, since 1890.

\* *Phil. Trans.*, B, ccviii, 225-250; ccix, 181-190.

In the first paper Brownlee established as "mathematical facts" that in London experience the following periods existed: 97, 87, 109½, 114 weeks; the amplitude of the first was much the greatest, but all were significant. To determine significance, Brownlee used Schuster's criterion. Whether better tests are available is a mathematical question which I do not feel competent to discuss; I shall assume that the periods *are* facts—mathematical or otherwise—viz., cannot be dismissed as mere random happenings. In the second paper Brownlee no longer treated London as a whole, but examined the course of events district by district. He concluded that the predominant 97 weeks' period was a phenomenon common to all districts, a synchronous development not suggesting interlocal spread. The 87 weeks' epidemic was quite different; as a major feature it was confined to the south of the Thames, and there was clear evidence of diffusion from a central focus. Brownlee then turned to the biological interpretation of periodicity. Did it depend on (a) a periodic change in the population at risk or (b) a change in the *materies morbi*? Of course he recognized the probable or possible concurrence of both factors, but for simplicity I take them as mutually exclusive. (a) is the traditional explanation, quantified by Hamer, and more recently by Soper. Brownlee deduced from the spatial distribution of the 87 weeks' epidemic, the way it spread, that one was not dealing with an exhaustion effect, a mere using up of the susceptible population, but a consequence of the waning power of the *materies morbi* to cause disease. He attached much importance to this because the larger phenomenon, the 97 weeks' epidemic, behaved in a unitary way for all London, without interlocal lags, and, under those conditions, analysis of the frequency distribution in time could not differentiate (a) from (b); on both hypotheses distributions would emerge which were statistically indistinguishable. So far, the matter is fairly simple. Whether Brownlee's inferences from the 87 weeks' data are statistically just, mathematical statisticians *may* question; the argument seems to me reasonable, but its exposition is terse, and I have no more than an elementary knowledge of the technique. The difficulty most of us have is in the biological interpretation. That the properties of a strain of micro-organisms may change through successive generations is well known. That such qualities as virulence and infectivity may vary independently is also known. What does a little daunt the imagination is the majestic movement of a periodic cycle of change, a sort of precession of a biological equinox, which Brownlee seemed to postulate for the 97 weeks' epidemic. It was also hard to accept the co-existence within the metes and bounds of one city, however large, of two quite independent phenomena. Hamer's friendly epigram—that it was wonderful children on opposite sides of Waterloo Bridge had different measles—like all epigrams, contained less than 100 per cent. of truth—Brownlee never did make an absolute dichotomy—but a real sting. But the great influenza of 1918 was a majestic phenomenon; the fact that it does not fit into any satisfactory theory, is a startling exception from "rules," does not allow us to speak of it as a "mathematical fact" and ignore it when we write about the epidemiology of influenza. Unless and until Brownlee's "mathematical facts" have been shown *not* to be facts, they remain to be fitted into a true theory of periodicity.

PROFESSOR R. M. F. PICKEN: We must count ourselves happy that Dr. Stocks has found time in the stress of war-time to study the great epidemiological experiment of evacuation. The possibility of influencing the behaviour of measles by deliberate administrative action had come to be widely doubted, except in so far as rural areas were concerned. Experience taught that simple closure of schools or the exclusion of known susceptible contacts from school had no demonstrable effect on the course of a town epidemic, even if these steps were taken with the greatest possible promptitude at the beginning of an outbreak. There were too many other avenues of contact than the school. In a partial report of an analysis of the notification records of Renfrewshire which I wrote in 1921 (*Proc. Roy. Soc. Med.*, 1921, XIV, 75) I included contrasting illustrations of the course of measles in an urbanized and an isolated rural area which showed

how many random infections occurred under school age in a town. Perhaps this contrast would now be less striking, since the child population has been so greatly diminished (the Renfrewshire observations were made between 1893 and 1912), the towns have become less congested and the parents more alive to the risk of exposing their children to infection. Dr. Stocks's findings make one think that administrative policy may have to be reconsidered. While the state of affairs in evacuation areas was quite exceptional and unlikely to be paralleled in peace-time, it is perhaps significant that high incidence rates should generally have come earlier in big reception towns, where schooling was less interrupted, than in large neutral towns. If the only clear difference between these two latter types of area in the winter 1939-40 lay in the opportunity to be infected at school, the differential incidence of measles may justify a revision of our ideas about the value of school closure as an administrative measure even in towns. Or it may be found practical to make a direct attack on transmission in school by radiant disinfection as advocated by the Wells (Wells, Wells and Wilder, *Amer. J. Hyg.*, 1942, 35, 97). Nevertheless I doubt whether the passage in Dr. Stocks's paper which is devoted to the effect of the Easter holiday on notifications of measles carries us much further towards this conclusion. At first sight his table is impressive, but notification is apt to have a varying relation to the date of onset of cases of a disease. If a large proportion of notifications are still made to medical officers of health by teachers, and by them only, and much of their information as to reasons for absence comes to them slowly after a holiday through attendance officers or otherwise, the fall during holidays and the delayed compensatory rise might not be a true measure of the time of incidence. I am not now in a position to explore this possibility during an epidemic period without putting other busy people to a great deal of trouble. That it is not fanciful, however, is shown by the fact that of 104 cases of measles coming to the knowledge of a local health department in July, August and September 1942, only 54 were notified by medical practitioners (34 of which were under school age), while as many as 50 were notified by teachers even during a period which included the longest holiday of the year. The circumstances which affect the timing of teachers' notifications therefore merit examination.

I doubt, also, whether Dr. Stocks strengthens his already convincing demonstration of the effect of evacuation and reduced schooling by arguing that some other explanations of the occasional breaches in the regularity of measles are invalid. I do not remember the use of the word "cosmic" in any scientific discussion of this subject, and it certainly explains nothing. But Brownlee's long study of this sort of problem began with the careful observation of certain facts when he was medical superintendent of a fever hospital. He recorded (*Proc. XVIIth Internat. Cong. Med., London, 1913, 151*) repeated occasions when the introduction of measles into a hospital ward failed to "cross" it during non-epidemic spells, in contrast to the high rate of infection when the circumstances were exactly similar except that measles was rife at the time in the community outside the hospital. He thought this must be due to periodical waning and sudden resumption of the infectivity of the virus. Dr. Stocks has himself studied this fluctuation in apparent infectiousness, and attributed it to the latent immunity acquired by children during an epidemic and lost in about two years (Stocks and Karn, *Ann. Eugen.*, 1928, III, 361). This is more in accord with the immunological behaviour of those diseases which, unlike measles, can be studied by laboratory methods, and equally well accounts for the biennial periodicity of the disease. But there was nothing fantastic about Brownlee's hypothesis, and indeed, so far was he from seeking a "cosmic" explanation, that he thought each area might harbour its own strain of measles virus, with its own inherent periodicity. Further, he thought that coincidence of the recovery of the infecting power of the virus and the appropriate season was the governing factor in enabling measles to strike; Dr. Stocks, in the paper to which reference has already been made, found some reason to believe that meteorological conditions might influence its "apparent infectiousness." Another feature of epidemic curves which impressed Brownlee was their tendency

to show a great swing in amplitude over some biennia and flatten out over other periods of time. In one of his papers (Brownlee, *Public Health*, 1915, XXVIII, 125) he gave a striking illustration of this phenomenon in the form of a chart of whooping-cough mortality in Sweden from 1774 to 1830. It was noticeable in Renfrewshire, where biennial exacerbations and intermissions of cases were very clear-cut from 1904 to 1912, the apices of the biennial peaks during this short series of years forming a smooth curve with its highest point in 1908. In the early 90's epidemics occurred in the odd calendar years, but a change took place in 1898, when the even years began to become predominant, although biennial prevalence was somewhat obscured until 1904. With the development of pronounced biennial periodicity the epidemics concentrated on mid-winter; earlier they tended to occur with less seasonal regularity, but usually in late spring or early summer. The mortality from measles in Glasgow, which abuts on Renfrewshire and was then overflowing into the country, followed the same trend. The monthly deaths from measles in Glasgow can be followed from 1855. At first the course was irregular, but a serious epidemic in 1860 was followed by an intermission of nearly two years, and then the odd years began to predominate, leading to big epidemics in 1869, 1871 and 1873, with a corresponding reduction of deaths in 1870 and 1872. The disease again seemed to feel its way until 1883, 1885 and 1887, when sharp outbreaks were separated by unusually low mortality in the intervening months. Again the biennial periodicity was obscured until heavy mortality in 1893, 1895 and 1897 was accompanied by very low mortality in the troughs of the waves. A similar course was followed until the severe outbreaks of 1906, 1908 and 1910, the even years having come to predominate from 1904 onward. Throughout this long period most of the epidemics occurred in the spring until 1895. From then onward the weight tended to be in mid-winter, and this feature was accentuated in the epidemics at the beginning of 1908 and 1910. The further course of events in Glasgow was interesting. (It is illustrated by a chart in the *Annual Report of the Medical Officer of Health for 1926*, showing the cases registered in four-week periods from 1900 to 1926.) From 1913 to 1920 measles occurred in almost equal volume each year, less violently than during the biennial winter waves of 1908, 1910 and 1912, and now almost always three or four months later in the year. By 1922 it had resumed biennial periodicity, and two years later great epidemics had again concentrated on the winter, with negligible incidence in the intervening years.

It was this cyclic behaviour of measles which generated in Brownlee's mind the idea of two waves, one seasonal, the other inherent in the virus, and having a length of nearly, but not quite, two years, these exercising interference on one another in the manner of beats, and lending themselves to unravelling by means of the periodogram. I am not concerned to maintain that he was successful in proving his case, but rather to reaffirm that there are peculiarities of behaviour in measles which recur over rather long periods, and are not demonstrably due to changes in social circumstances. It was not a flight from reality into the cosmos. Brownlee tried to fit into one theory certain disparate facts, the seasonal incidence, the biennial wave, the long cycle and the skewness of the individual epidemic. It was a good example of the scientific method. If for almost biennial renewal of vitality of the virus were substituted loss of acquired latent immunity among children, the theory might still hold.

When measles is changing its stride epidemics, not large, but considerable, are apt to occur in years when they are not expected. Sometimes, as in 1861 and 1862 in Glasgow, there is an abnormally long period of intermission. Dr. Hilda Bull has commented on the extraordinary fact that there had probably been no measles in Victoria, Australia, and very little in the whole Commonwealth during 1936, 1937 and 1938. "There is no similar record of such a prolonged absence of the disease in the past twenty years" (*Bull. Med. Jour. Aust.*, Feb. 17, 1940, 228). It returned in 1939 with renewed force.

It is therefore not surprising that there should have been scepticism about the influence of evacuation in delaying the onset of measles in this country in

1940. Dr. Stocks's demonstration of the course measles and whooping cough followed in different types of area, coupled with his earlier analysis of the effect of evacuation on diphtheria and scarlet fever, seems to prove conclusively that this deliberate interference with the normal life of the child community played at least a large part in the course of epidemiological events. It is a most valuable series of studies of the results of an involuntary experiment which may never be repeated on the same scale.

DR. W. N. PICKLES: From Dr. Stocks we have the good news that measles and whooping cough show definite signs of diminishing severity and that both may soon become unimportant as causes of death. Before assuming, I suppose, a change in the virulence of the infecting agents as has taken place at intervals in scarlet fever, it would be as well to assess the effect of improved child health, the rarity of rickets, and the modern facilities for treatment in reducing the mortality.

The results of school closure, represented by the Easter Holidays, is of great interest. I have advocated, and practised with some success, school closure a week after the advent of the *first* sufferer. This I believe to be of much benefit in a scattered country district, where children do not mix freely out of school.

Unlike town experience, epidemics of measles appear in my own country district every nine years—this I have frequently discussed with Dr. Stocks, to whom it causes no surprise.

1911, 1920 and 1929 were epidemic years and 1938 saw the dawn of a similar outbreak in one village. By closure of the school at the outset and by virtually placing the village in quarantine, forbidding attendance at the grammar school, which serves a large area, of the elder children contacts, the epidemic was brought to a dead end.

Since the outbreak of war, 135 notifications of measles (total population 3,500) have been made, 6 only in visitor children. Of the four separate outbreaks one only was introduced by a visitor child who contracted the disease in a ship returning from India.

During the same period there have been 112 notifications of whooping cough, 18 in this case being in visitor children.

DR. W. J. MARTIN: As is always the case, a paper by Dr. Stocks is interesting and informative and provides us with matter for reflection. The present paper, perhaps, gives rise to more speculations than the preceding one dealing with diphtheria and scarlet fever. The introduction arouses the first speculation, what is the effect of wrong diagnosis on the totals? The returns for measles certainly include some cases of rubella, whilst whooping cough in an atypical form may escape recognition. Are these errors large enough to affect any estimation of the percentage of children attacked?

The bulk of the deaths are from children under school age who are infected by the elder children. A lag of two weeks between the rise of the epidemic and of the deaths seems rather a brief interval to allow for infection, incubation and illness. An examination of the weekly returns for the great towns for 1940, the only data available, shows that the number of deaths did not rise until the 35th week, although the notifications had been slowly increasing. Dividing the period before the deaths increased into two periods, the totals for the first 17 weeks were 28,942 notifications and 88 deaths, and for the second 17 weeks 57,267 notifications and 89 deaths. The number of deaths in the 37th week were 14, over twice the preceding weekly average, but for each of the preceding three weeks the notifications were lower than in any of the previous 13 weeks. This comparison suffers from the defect that deaths were ascribed to place of occurrence, but as a rough check on the size of the error the quarterly returns for the whole country can be used; these give:—

Quarters of 1940				Notifications	Deaths
March	...	...	...	50,642	152
June	...	...	...	86,513	140
September	...	...	...	104,808	171
December	...	...	...	167,630	394

It seems from this rather approximate test that an estimation of the commencement of the epidemic from the deaths would have resulted in an error of many weeks. In the earlier periods, when the mortality was several times larger than the modern experience, a closer relation between the increase in deaths and rise in incidence may have existed.

Brownlee's work on periodicity (with which, perhaps, Dr. Stocks has been a little too severe) led him to the belief that periods of different length were experienced in South London to those in areas north of the Thames. Although one epidemic affords little evidence either to support or refute his theory, it is a matter of interest that the curve of the notifications, summed in four weeks, for London was bi-modal. During the first peak at 1-4 weeks of 1941 there were 1,242 cases notified in the boroughs north of the Thames and 666 cases in South London, but during the second peak in 17-20 weeks there were 784 cases reported in the north and 807 cases in the south, *i.e.*, the number of cases in the second maximum showed a decline of 37 per cent. for North London and an increase of 17 per cent. for South London when compared with the totals of the first peak.

It is not clear to me why children attending school part time only made half the contacts of children attending whole time. The part-time school meant more crowded conditions in the classrooms, since, owing to the Government's policy of commandeering schools and the reluctance to release them, one school had to serve in place of several. As a result of these conditions the children did not make less contacts, but suffered a shorter but possibly more intense exposure to risk of infection. Although school attendance is undoubtedly a factor of great importance in the spread of measles there is perhaps not quite the perfect correlation that the paper would lead us to believe. Exceptions can be found in various areas, due possibly to a varying endemic level or to local differences in the course of an epidemic. That such differences existed before the war is suggested by the returns during the 45-48 weeks of 1939, when 2,148 cases occurred in Wales, 1,407 in the West Midland Counties, 1,187 in the Northern Counties, but in the combined area of the South East, South Midlands, Eastern Counties and London only 581 notifications occurred. The urban districts of Cumberland experienced their maximum during this month, 346 cases being reported, and only odd cases occurred during the period when the incidence in the country as a whole was at a maximum.

MR. W. T. RUSSELL: Dr. Stocks has amply fulfilled his promise to investigate the effects of dispersal of the child population on the incidence of measles and whooping cough, and the paper now submitted to the Society will be of great interest and value to all students of Public Health. I think, however, he is inclined to over-stress the part played by school contact, important though it is, in the spread of these two infections. The measles epidemic was nearly a year late in attaining its maximal incidence in London, *i.e.*, first quarter of 1941, and this fact may be attributed to the diminished school contact. But in Leeds, where there was relatively little evacuation, and consequently little disturbance of school life, the epidemic also did not reach its peak value until the first quarter of 1941. According to the table showing the frequency of the time of the year when epidemics started during the period 1871-1937, the Michaelmas term was the most frequent, but the experience of individual cities was not uniform. For example, in Liverpool there were just as many epidemics in the Summer term as in the Michaelmas term, and in Leeds 30 per cent. of all the epidemics in that city began in the Summer term. Accordingly, the difference between the time of onset of the epidemics, or in the attainment of their modal incidence, in the five cities listed on page 273 may represent nothing more than time variations which could have existed, or possibly did exist, in the pre-war statistics for these towns.

Since the paper deals with the effects of dispersal, I think it would have been better if the author had compared the Evacuated Areas with the Reception Areas, and not with the Neutral Areas, because in the Neutral Areas there was



some discontinuity of school life, whereas in the Reception Areas there was presumably none. Even in the Reception Areas the epidemic did not run true to time, because the results in those areas in the Midland and North are entirely different from those in the South. In the former the notification rates per 10,000 children in each of the four quarters of 1940 were 546, 628, 536 and 792, the corresponding rates in the South were 135, 245, 276 and 592. As only the number of notifications, and not the rate in these contrasted areas are given in the paper for the first and second quarters of 1941, we cannot say if there was any change in the number of children exposed to risk. Relying on the notifications in each of those two quarters, and comparing them with those in the last quarter of 1940, the position was as follows:—

				1940		1941
				4th Quarter	1st Quarter	2nd Quarter
Reception Areas:						
Midland and North	...	...	...	16,669	13,877	11,299
South	...	...	...	22,983	54,680	35,574

These statistics show that even in the Reception Areas, where presumably there was uninterrupted school contact, there was a variance in the time of modal incidence.

The author's comments on Brownlee's work on periodicity particularly interest me. In reading this section of the paper one would get the impression that Brownlee either ignored or was ignorant of the existence of those factors now cited by Dr. Stocks—factors which might have modified the periodicity he discovered. Those who worked with Brownlee knew that he was fully aware of their presence, but he refused to regard them as *the* basic consideration. As regards the importance of these variables, it must be remembered that Brownlee's investigation covered the period 1838–1914, during which the rate of decline in the birth rate was not nearly so dramatic as that which has occurred since 1914. With reference to the seasonal mortality I would point out that the vast change indicated by the figures in page 260 did not occur until after 1911. In other words, the bi-modal seasonal incidence practically existed throughout the seventy-five years covered by Brownlee's analysis. It is probably true that, in some instances, he concentrated too much on the biology of the causal organism and did not pay sufficient regard to environmental improvements. But it is equally true that there would appear to be some justification for his belief that the periodicity of a disease which had a bi-modal seasonal incidence could not be explained solely on the basis of the accumulation of susceptible children. I have tried to convey that Brownlee was a biologist as well as a statistician. If, from a statistical survey of diphtheria prior to 1931, he had postulated the existence of three main types of diphtheria, he would have been severely criticized, but we now know this to be a bacteriological reality.

DR. STOCKS, in reply: I am grateful to those who have contributed so usefully to this discussion, and need say little in reply. If I have seemed to give scant justice to Dr. Brownlee's work it is certainly not because I do not recognize the great value of his painstaking contributions to the subject. I agree with Mr. Russell that a time may conceivably come when more than one variant of measles has to be acknowledged, but my feeling is that until we have better evidence of that than we possess at present we should endeavour to account for the complexities in the behaviour of the disease in other ways rather than postulate variations in type. Professor Picken takes me to task for using the word "cosmic," but I would remind him that Crookshank in his *Epidemiological Essays* speaks of "what used to be called telluric and cosmic influences" in connection with the periodicity of influenza; and discussion of the significance of these terms has been revived recently in America (I. Galdston, *Bulletin of New York Academy of Medicine*, September 1942). By cosmic, for want of a better word, I meant those unexplained influences which suddenly produce world-wide variations in a disease such as were manifest in the influenza pandemic of 1918–19 and perhaps also in the widespread epidemics of variola

minor during the third decade of this century. Such influences are distinct from the effects produced by local climatic peculiarities or by changes in social habits and environment, such as the herding of people into tenements, the congregating of children in schools and the decreasing size of family, which we might term telluric.

Professor Picken suggests that notifications made by teachers, being influenced by a school holiday, might be responsible for the apparent effects of the Easter holiday on the notification figures, but he overlooks the fact that notifications as reported to the Registrar-General—and these were the figures used throughout the paper—are, save in a few areas of no statistical significance, confined to the cases notified by medical practitioners. Thus, in the example he quotes, only the 54 were reported to the Registrar-General and used in the statistics. The teachers' notifications often duplicate those already notified by doctors, and even if they do not, they are not intended to be included amongst "notifications" as required by the regulations, and rarely are so included. This results in some understatement of the total incidence, but that matter I discussed in the first paragraph of the paper.

Dr. Martin thinks that children attending school half-time should not be considered to have been subjected to half the normal contacts with other children. I don't think he is justified in saying that "part-time school meant more crowded conditions in the class rooms," since the policy was not to mix the two sets of children, but if room was scarce, to arrange alternate sessions in the same building. I assumed, therefore, that during a single session the child would be exposed to half as many contacts as during two sessions, and I do not think any serious error is likely to be involved in that assumption.

Dr. Pickles tells from his own experience what occurred in his own rural area, and in a few words makes, as always, an invaluable contribution to the discussion. The progress of epidemiology would be helped if his example could be followed by a score or two of other rural medical practitioners who are also Medical Officers of Health in their areas. It is to be hoped that in the impending reorganization of medical services this aspect of epidemiology will not be forgotten.

## MISCELLANEA

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## BASIC IDEAS AND SOME RECENT RESULTS OF THE THEORY OF TESTING STATISTICAL HYPOTHESES \*

By J. NEYMAN

1. I should like to express my deep gratitude to the International Institute of Intellectual Co-operation, and particularly to Mr. A. Establier, the Head of the Scientific Relations Service, for having thought of me when planning the present meeting. I feel honoured by the invitation to read a paper and am very glad to contribute what I can to the success of this enterprise of international collaboration. The pleasure in participation is increased only by the fact that the subject on which I have to report is particularly suitable for discussion here. It is since only very recently that the theory of testing statistical hypotheses is being more or less systematically developed, and then the number of different nations, whose members made important contributions to the subject, is surprisingly large. Taking into account only more important recent theoretical contributions, we shall be able to count no less than twelve nations. Of course, the number of nations whose members used or discussed some of the results of the theory is much greater. Consequently, I think I am justified in considering the theory of testing statistical hypotheses as a product of international co-operation.

2. In spite of the intensive creative work now going on in various centres, there appears to be a considerable amount of confusion as to what are basic ideas of the theory of testing statistical hypotheses. This is connected with the fact that this theory is essentially a part of the theory of probability, and that there are many different and conflicting points of view on the foundations of the theory of probability itself, and on its relationship to problems of application. In some ways the disagreements on the theory of testing hypotheses may be even more intense than on the theory of probability. It is known, in fact, that there are certain chapters of the latter which are independent of the particular school of thought. Such are, for example, the theorems on the laws of large numbers, which are equally valid whether we start from the point of view of v. Mises, of Kolmogoroff or of that of the school of subjective probabilities. Whichever may be the fundamental point of view on what is the mathematical probability, there are, therefore, chapters which are, so to speak, indisputable. It is not so with the theory of testing statistical hypotheses. It is being built up having in view a certain class of practical problems and is essentially attached to one par-

\* A paper presented at the Study Meeting on the Applications of Calculus of Probability organized by the International Institute of Intellectual Co-operation, League of Nations, and held in Geneva, July 12th-15th, 1939.

ticular point of view, if not on the definition of probability, then on its connection with certain phenomena in the outside world. Consequently, whoever adheres to this particular point of view on probability may be interested in the theory of testing statistical hypotheses. On the other hand, this theory is likely to be considered as useless by those whose point of view on probability is different.

3. The point of view of mathematical probability which is basic for the theory of testing statistical hypotheses seems to be historically the oldest. It is that the theory of probability constitutes a mathematical model of those observable phenomena, which we roughly describe as the results of repeated random experiments. In the times when the theory of probability was originally built up, the only repeated random experiments considered were the repeated games of chance, and the mathematicians were asked to solve various problems as to how often any particular combination of results is to be expected. The idea that the mathematical probability of an event is a conceptual equivalent, or correspondent, of the observable relative frequency of this event in a series of repeated trials can be easily traced in the early writings on probability. There were also attempts to test empirically the rightness of some theoretical results.

But very soon another point of view on probability seems to have developed. According to this, which is also very well represented in the modern literature, the concept of probability need not, or even should not, be connected with any relative frequency. It is just *the* probability, the intensity of our belief, dependent on the information available. It may be useful to label these two directions of thought at once. Without insisting in any way on the appropriateness of the terms, I shall call the first of the two above points of view the classical, and the second the subjective point of view on probability.

We must be clear on the distinction between them. Consider the following simple statement. "The probability of  $E$  is  $p$ ." From the classical point of view  $p$  represents some sort of "theoretical" relative frequency of  $E$  in a certain sequence of instances, which require careful specification. If, for example,  $p = \frac{1}{2}$ , this suggests that in a long series of those specified cases (experiments or observations) the relative frequency of  $E$  will be, or is, about equal to  $\frac{1}{2}$ . Consequently, if  $E$  stands for "the existence of life on the planet of Mars," it is difficult to interpret  $p$  from the classical point of view. Of course we can say that, as there is only one planet of Mars, the sequence of instances considered consists of one member only and, therefore, the relative frequency of  $E$  within this sequence, whatever this  $E$  may mean, must be either zero or unity. Thus the value of  $p$  must be either  $p = 0$  or  $p = 1$ , and until we have some definite information concerning  $E$ , we shall not be able to say anything more definite about  $p$ . It is obvious therefore that the classical interpretation of  $p$  in this and similar cases, where the sequence of instances consists of one member only, is uninteresting and futile.

The situation is different if we adopt the subjective point of view. There is considerable variation of, say, radicalism, among the present proponents of this theory. The most radical seem to be the writings of Jeffreys [1]\*, for whom to any proposition, on any amount of information, there corresponds a perfectly determined probability, which has nothing to do with frequencies. However, I could not quite follow the method of actually determining those probabilities.

\* Figures in square brackets refer to the list of references at the end of the paper.

A less radical point of view is represented by Borel [2], for whom, whenever possible, the probability does represent a mathematical correspondent of the observable relative frequency, but who does not deny the possibility of usefully considering the probabilities of isolated instances. His remarkable book just mentioned gives also very interesting methods of actually determining those probabilities and also the methods of checking them.

From such subjective points of view the probability of there being life on the planet of Mars may have any value between zero and unity, depending entirely on the relevant information available.

4. Before proceeding to the question of how the point of view on the applications of the theory of probability affects that on testing statistical hypotheses, it may be useful to mention a division within the category that I termed classical.

Let us repeat. I denote by the term classical point of view on the relationship between the mathematical theory of probability and the applicational fields, that point of view, according to which the theory of probability constitutes a mathematical model of the behaviour of the relative frequencies of various events in repeated trials. It will be observed that this does not imply anything concerning the definition of mathematical probabilities. The point I should like to make is that what I call the classical point of view covers both the theory of probability as summarized by Kolmogoroff [3] and also the new theory as founded and advocated by v. Mises [4]. Of course the definitions of the two theories are very different and there is a great amount of controversy about them. Some authors still think that the basic conception of the v. Mises theory, that of the Kollektiv, is intrinsically inconsistent. I believe, however, that all the attempts to show this inconsistency have failed so far and, moreover, that probably it will be possible to show that, if such inconsistency existed, it would also be present in the old theory of probability. The only thing that might be usefully done is to make a little more precise the conception of the so-called "place selections." Interesting work on this subject has been carried on by Copeland [5] and by Wald [6]. As far as I can see, from the point of view of applications both theories are equivalent and the choice between them is very much that of taste. To my own taste the old theory has the advantage of familiarity of the concepts. On the other hand, it cannot be denied that the method of approach of v. Mises has the advantage of frankly and directly attacking the problem of a model of the phenomena of the outside world, for the study of which the theory of probability has been invented.

5. Although the relationship between the theory of probability and the fields of application, in the classical meaning of the words, has been recently discussed elsewhere [7], it will be useful to restate here briefly certain points.

Any application of the theory of probability that we shall consider will consist in an attempt to predict the relative frequency of phenomena of some specified class in a long sequence of trials. Such predictions are possible only when we start our calculations with *some* knowledge concerning the relative frequencies of some other phenomena in some related trials. This assumed knowledge must be based on extensive empirical investigations. Let us illustrate the above short description by a familiar example.

Many careful experiments have confirmed the validity of Mendel's Law of heredity. In its simplest form relating to a single pair of allelomorphs  $A$  and  $a$ , it may be stated as follows.

Whatever be the genetical composition of the parent organisms,  $X_1$  and

$X_1$ —viz., pure dominant  $AA$ , hybrid  $Aa$  or recessive  $aa$ , the progeny  $Y$  inherits the character in question as if it were selecting one gene at random from each of the parents, the probability of any particular gene being selected being equal to  $1/2$ .

It will easily be seen that in the above form Mendel's Law constitutes a probabilistic or stochastic model of the heredity which, interpreted in actual phenomena, implies that

(i) If  $X_1 = AA$ ,  $X_2 = aa$ , then all the progeny will be of the type  $Aa$ .

(ii) If  $X_1 = Aa$ ,  $X_2 = Aa$  and the number of the progeny is considerable, then about 25 per cent. of them will be dominants,  $AA$ , about 50 per cent. will be hybrids,  $Aa$ , and about 25 per cent. will be recessives.

These and similar consequences of the Mendelian Law were checked many times directly and indirectly and, at least with respect to some hereditary characters, they never failed. We describe this fact by saying that the phenomena of inheriting the character under consideration have the property of randomness and conform to the Mendelian Law as stated above. Now this law may be used as a basis for calculating probabilities of a number of various events. This of course, could be done without the empirical checks of the validity of the law, but then the results of the calculations would not have the important meaning they actually possess. This consists, in fact, in that, if the probability of an event,  $E$ , calculated only on the basis of the Mendelian Law is, say,  $1/100$ , then it means that in a long series of experiments this particular event actually happens about once in a hundred times. Primarily this conclusion applies to the hereditary experiments already carried out and found to be conforming with the Law of Mendel. We expect it to be also true in the future, just as confidently as we expect the Mendelian Law to be true.

The event  $E$  mentioned above may be some hereditary phenomenon, but it may be also something else, in which we are particularly interested here, some particular hypothesis being true or false. Before we proceed to the discussion of this particular point it may be well to make a short digression and to remind ourselves of a few definitions.

6. We might perhaps have to start with the definition of probability. This, however, would have been too far from our particular subject, and therefore I shall mention only that the term probability should be understood either in the sense of Kolmogoroff as explained in my *Lectures and Conferences* quoted above, or in the sense of v. Mises (*loc. cit.*). I shall explain only the notation to be used below. Thus  $P\{E\}$  will denote the probability of an event  $E$ . If it is desired to emphasize that this probability is calculated on some assumption  $A$ , then we shall write  $P\{E|A\}$ . Denote by  $X_1, X_2, \dots, X_n$  some  $n$  variables, and by  $E$  their set which we shall conveniently represent by a single point in a space,  $W$ , of  $n$  dimensions. The space will be called the experimental space, and the point,  $E$ , the experimental point. Its co-ordinates will be the values of the variables  $X_1, X_2, \dots, X_n$ . Denote further by  $w$  any region  $*$  in the space,  $W$ .

If the variables  $X_1, X_2, \dots, X_n$  have the property that, whatever the region  $w$ , there is defined a probability,  $P\{E \in w\}$  of the event point belonging to that region, then these variables are called the random variables. The probability  $P\{E \in w\}$ , considered as a function of the region, is called the integral probability law of the variables,  $X_1, X_2, \dots, X_n$ .

\* To be more exact: any measurable set.

The above definitions of the general theory of probability allow us to proceed to those concerning its particular part, the theory of testing statistical hypotheses.

Let  $X_1, X_2, \dots, X_n$  be some random variables, and denote by  $P\{E \in w\}$  their probability law, which we shall assume to be unknown. Any assumption concerning the probability law  $P\{E \in w\}$  will be called a statistical hypothesis [8]. The statistical hypothesis,  $H_1$ , is called simple if it specifies the probability law  $P\{E \in w\}$  as a single valued function of the region  $w$ . Otherwise it is called composite.

When discussing the applications of the theory of probability, it is very essential to make special efforts in order not to confuse the conceptual with the perceptual spheres of our thought. The above definitions, as all definitions in the strict sense of the word, are entirely in the conceptual sphere. The probability is our conception, and so are the random variables and their probability laws. But these conceptions imitate some real observable phenomena. And the conception of some random variable  $X$  is an abstract model, or imitation, or correspondent of a variable,  $\xi$ , the value of which is determined by what we agree to call a random experiment: if this experiment is repeated many times, then the frequencies of the various possible outcomes, and also the frequencies of various combinations of those outcomes, are in a sufficient agreement with the theory of probability.

7. Let us now turn back to the Mendelian Law and use it again for illustration. Assume as known that two individuals  $X_1$  and  $X_2$  are both hybrids—i.e., that  $X_1 = X_2 = Aa$ —and denote by  $Y_1$  their progeny, so that

$$X_1 \times X_2 = Y_1 \dots \dots \dots (1)$$

Assume further that  $Y_1$  has the appearance of a dominant. Obviously in that case it may be either a dominant  $AA$  or a hybrid, and the probabilities of the two assumptions are

$$P\{Y_1 = AA\} = 1/3, P\{Y_1 = Aa\} = 2/3 \dots \dots \dots (2)$$

Now consider a further cross between  $Y_1$  and another individual  $Y_2 = aa$  recessive in character. Suppose that the progeny of this cross consists of  $n$  individuals  $z_1, z_2, \dots, z_n$ , and denote by  $k$  the number of pure recessives among them.

Now we have all the elements needed for the illustration of the above definitions. The variable  $k$  may be considered both in the perceptual and in the conceptual sphere. When we speak of the Mendelian Law, of the *probability* of an individual inheriting this or that gene, etc., we are in the conceptual sphere and we are able to calculate probabilities of  $k$  having this or that value. Thus  $k$  is what we called a random variable. On the other hand,  $k$  may be also considered as a variable, the actual value of which will be determined by a real genetical experiment we are about to carry out. The relation between the two is what I have just described: repeated real experiments have always given in the past the frequencies of the various values of  $k$ , very close to those predicted by the theory of probability.

Now let us calculate the probabilities of the different values of  $k$ . Those values are, in general

$$k = 0, 1, 2, \dots m, \dots n \dots \dots \dots (3)$$

All those values are possible if the individual  $Y_1$  is a hybrid and, on this hypothesis

$$P\{k = m | Y_1 = Aa\} = \frac{n!}{m!(n-m)!} \cdot \left(\frac{1}{2}\right)^n, \text{ for } m = 0, 1, 2, \dots, n \quad (4)$$

On the other hand, if the individual  $Y_1$  is a pure dominant, then any of its offsprings is certain to inherit a dominant gene  $A$  and, therefore, will fail to be a recessive. Consequently, the number  $k$  of recessives among the  $n$  offsprings of the cross  $Y_1 \times Y_2$  will have to be zero, so that, on the assumption  $Y_1 = AA$ , we have shall

$$\left. \begin{aligned} P\{k = 0 | Y_1 = AA\} &= 1 \\ P\{k = m | Y_1 = AA\} &= 0, \text{ for } m = 1, 2, \dots, n \end{aligned} \right\} \quad (5)$$

Now we may illustrate the conception of the statistical hypothesis. We have just found that the probability of the variable  $k$  having any specified value depends on what is actually the genetical composition of  $Y_1$ . If  $Y_1 = Aa$ , then it is determined by the formula (4), otherwise by the formula (5). Obviously (4) and (5) determine what we call the integral probability law of the random variable  $k$  and, as far as we do not know the genetical composition of  $Y_1$ , this law is unknown. Now either of the assumptions,  $H_1$ , that  $Y_1 = Aa$ , or  $H_2$ , that  $Y_1 = AA$ , is equivalent to a particular assumption concerning the probability law of  $k$ . Consequently both those assumptions are what we call the statistical hypotheses.

It is easy to see that in the conditions of the problem considered both hypotheses  $H_1$  and  $H_2$  are simple. In fact, assuming any of them, the probabilities  $P\{k = m\}$  appear to be unambiguously determined. It would have been different if we did not have any precise knowledge on the genetical composition of the individual  $Y_2$ .

To see this, assume a slightly different situation where it is known only that  $Y_2$  is not a recessive. In that case we shall have the following possibilities:

(i)  $Y_1 = Aa$ ,  $Y_2 = Aa$ , and we shall have

$$P\{k = m | (Y_1 = Aa)(Y_2 = Aa)\} = \frac{n!}{m!(n-m)!} \cdot \left(\frac{1}{4}\right)^m \left(\frac{3}{4}\right)^{n-m} \quad (6)$$

(ii)  $Y_1 = Aa$ ,  $Y_2 = AA$  and

$$\left. \begin{aligned} P\{k = 0 | (Y_1 = Aa)(Y_2 = AA)\} &= 1 \\ P\{k = m | (Y_1 = Aa)(Y_2 = AA)\} &= 0, \text{ for } m = 1, 2, \dots, n \end{aligned} \right\} \quad (7)$$

(iii)  $Y_1 = AA$ ,  $Y_2 = Aa$  and the probability law of  $k$  is the same as in (ii).

(iv)  $Y_1 = AA$ ,  $Y_2 = AA$  and the probability law of  $k$  is the same as in (ii) and (iii).

It follows that in this particular case the hypothesis  $H_2$  that  $Y_1 = AA$  is again simple: whatever the other circumstances of the problem, it determines uniquely the probability law of  $k$ . On the other hand, the hypothesis  $H_1$  that  $Y_1 = Aa$  is now composite. In fact, if it is true, then the probability law of  $k$  may be either as given by (6) or by (7).

8. The first attempts to test statistical hypotheses by means of the theory of probability were connected with the famous formula of Bayes. Denote by  $c_1, c_2, \dots, c_s$  some  $s$  mutually exclusive random events, such that one of them is certain to happen, and by  $P\{c_i\}$  the probability of  $c_i$ . These events are to be described as "causes." Next let  $E$  be some other event which can be directly



observed, and denote by  $P\{E|c_i\}$  its probability calculated on the assumption that  $c_i$  has already happened. Finally let  $P\{c_i|E\}$  denote the probability of  $c_i$  calculated under the assumption of  $E$  actually happening. The probabilities  $P\{c_i\}$  are called the *a priori* and  $P\{c_i|E\}$  the *a posteriori* probabilities of the cause  $c_i$ . With this notation the well-known formula of Bayes gives

$$P\{c_i|E\} = \frac{P\{c_i\}P\{E|c_i\}}{\sum_{j=1}^s P\{c_j\}P\{E|c_j\}} \quad \dots \quad (8)$$

The question of the usefulness of this formula or, perhaps, the very legitimacy of its application to practical problems constitutes the point of disagreement between the classical and the subjective points of view on testing hypotheses. The representatives of the subjective theory seem to think that the formula (8) may be always applied, at least in principle, and gives all that one could wish. On the other hand, according to the classical point of view, in a great many practical problems there are not sufficient data on which to base the calculation of the right-hand side of (8), and consequently, if we desire to use the theory of probability for testing hypotheses, some new method of attack should be invented. For a long time it seemed even to be a general opinion that *no* practical problem involved data sufficient for the calculation of (8). This I believe not to be exact. We shall use the above discussion of the Law of Mendel to show a simple example of a problem involving all the data necessary for calculating (8), one of the many analogous ones, provided by genetics and, in particular, by plant-breeding. A small modification of the conditions in this example will illustrate the situation where, according to the classical point of view, the formula (8) becomes inapplicable.

9. Consider again the cross of two hybrids  $X_1 = X_2 = Aa$  and its progeny  $Y_1$ , having the appearance of a dominant. Assume that  $Y_1$  is again crossed with a recessive  $Y_2 = aa$  and produces  $n$  offspring,  $z_1, z_2, \dots, z_n$ . Assume that none of these offspring is a recessive, which is consistent with  $Y_1$  being either a dominant or a hybrid.

In order to bring this situation into correspondence with the above outline of the Bayes theory, we may notice that what we have there denoted by  $E$  constitutes the fact that all the  $n$  offspring  $z_i$  have the appearance of dominants. Again  $c_1$  may be identified with  $Y_1 = Aa$  and  $c_2$  with  $Y_1 = AA$ , so that  $s = 2$ .

Consider now the situation where it is desired to test the hypothesis  $H_1$  that  $Y_1 = Aa$ . The situations of this kind arise in problems of breeding, where the desirable type of organism is the dominant.

It will be seen that all the elements necessary for the calculation of the probability *a posteriori* of the hypothesis  $H_1$  are present in the conditions of the problem. Thus the formulae (2) give the probabilities *a priori* of the two possible hypotheses, and from the formulae (4) and (5) we can easily obtain the probabilities of the facts observed,  $E$ , calculated on each of these hypotheses.

$$P\{E|Y_1 = Aa\} = 1/2^n, P\{E|Y_1 = AA\} = 1 \quad \dots \quad (9)$$

Thus, as it is easy to find, the probability *a posteriori* of  $H_1$  is given by

$$P\{Y_1 = Aa|E\} = \frac{1}{1 + 2^{n-1}} \quad \dots \quad (10)$$

Substituting for  $n$  the successive values 1, 2, 3,  $\dots$ , we shall get the following little table, which has a direct interpretation in the problem of breeding.

TABLE I  
*Probabilities a posteriori of  $H_1$*

$n$	$P\{Y_1 = Aa E\}$
1	0.500
2	0.333
3	0.200
4	0.111
5	0.052
	etc.

Suppose that the breeder engaged in producing a stock of organisms dominant with respect to the pairs of genes  $Aa$ , has to deal with the offspring like  $Y_1$  of crosses between two hybrids. Before putting them on the market he decides to make a test by crossing each individual  $Y_1$  back to a recessive. Of course, if at least one of the offspring,  $z_1, z_2, \dots, z_n$  of that last cross is a recessive, this means that  $Y_1$  is a hybrid, and it will be discarded. But what would be the consequences of the organisms like  $Y_1$  being put on the market if each of them, crossed with  $Y_2 = aa$ , produced, say,  $n = 3$  offspring, all of them having the appearance of dominants? The above little table gives the answer to just this question. It says that, with  $n = 3$ , the probability *a posteriori* of  $Y_1 = Aa$  is equal to 0.200. Consequently, if the pair of genes under consideration does follow the simple Mendelian Law explained above, then among a long series of organisms like  $Y_1$ , all of them obtained from a cross between two hybrids, and all of them having produced three offspring when crossed with  $Y_2 = aa$ , none of these offspring being a recessive, there will be approximately 20 per cent. of hybrids.

Probably, having this result, the breeder will consider that the percentage of hybrids to be expected in his stock is a little too large, and he will decide on a more thorough test of each individual  $Y_1$ , say with  $n = 5$ , which will reduce the percentage of hybrids to something just above 5 per cent.

This is an example of the application of the Bayes' theorem to testing hypotheses, which is legitimate from the classical point of view. It will be noticed that the formula (8), or the above table, does not have any intelligible interpretation when we try to apply it to just one individual  $Y_1$  of the kind discussed. But, as in the problem of breeding, we are frequently concerned more with the frequency of certain circumstances than with what happens in single particular cases. Then the classical probability will be of value.

10. Let us now change a little the conditions of the problem just considered and assume that we do not know anything about the origin of the individual  $Y_1$ . In that case, and in a strict adherence to the classical point of view, we should say that the probabilities *a priori*  $P\{Y_1 = Aa\}$  and  $P\{Y_1 = AA\}$  are simply unknown and, therefore, that we have not sufficient data to calculate  $P\{Y_1 = Aa|E\}$ . It is not so from the radical point of view of subjective probability. As I have already mentioned, I cannot very well follow the writings of Jeffreys, but it would seem that, there being only two possibilities of  $Y_1$  being either a dominant or a recessive, in the lack of any further information, he would assume  $P\{Y_1 = Aa\} = P\{Y_1 = AA\} = 1/2$ . Consequently he would get from (8)

$$P\{Y_1 = Aa|E\} = \frac{1}{1 + 2^n} \quad \dots \quad (11)$$

a formula which is similar to (10) but not identical with it. But the difference or the identity of the two formulae does not matter very much. Occasionally the adherents of the subjective probability assume probabilities *a priori* starting with some more complicated principles, and it is just possible that also in this particular case the values of the probabilities *a priori* of the two hypotheses  $H_1$  and  $H_2$  will be assumed to be exactly as in (2). Instead of getting (11), one would get for the probability *a posteriori* of  $H_1$  the formula (8), which would imply the above table. Still, from the classical point of view this procedure will not be considered legitimate, and the reason for this is that either the formula (11) or (10) would not admit the frequency interpretation as described above. Assume, in fact, that a breeder has purchased a great number of individuals like the individual  $Y_1$  described above, knowing only that it has the appearance of a dominant, but being totally ignorant as to their origin. Suppose that he tests them all exactly as described above, so that each is forced to produce  $n = 3$  offspring in a cross with a recessive, and that he is retaining only those individuals  $Y_1$  which did not produce any single recessive. The value of the subjective probability of  $Y_1 = Aa$  may be either 0.200 according to (10) or 0.111, according to (11). Those numbers are supposed to measure the intensity of our belief that any one of the retained  $Y_1$ 's is a hybrid, but they have no relation whatever to the actual frequency of hybrids which will be retained by the breeder after the test. If his source of the material acquired was unluckily chosen, then all the individuals bought may have been hybrids. His test will discard a considerable part of them, but it will retain a certain amount and all the 100 per cent. of the retained will be hybrids.

This is the actual sense in which I have used above the word "illegitimate," to describe the application of the Bayes' formula when the probabilities *a priori* are not given by the problem and have to be invented. Admittedly the words "legitimate" and "illegitimate" are not well chosen. There is no law yet which prohibits the calculation of any formula on any data. But the point is that, if we do calculate the formula (8) in a way that I described as "illegitimate," then it would not be legitimate to expect that the result will have frequency interpretation that the classical point of view would suggest. Therefore, if one is interested only in the "intensity of belief" that  $Y_1 = Aa$ , he may find it useful to measure it by means of the Bayes' formula. If, however, he wishes to know something more definite about the relative frequencies, say of successes in selection and breeding, and the necessary *a priori* probabilities are missing, then the formula of Bayes will not help him very much, in fact it will not help him at all.

Before I proceed any further, it may be useful to point out that the above example of the problem of breeding is not exactly what the breeder is actually faced with: it is a little schematized and simplified.

11. The above discussion is meant to introduce you to the practical problems which originated the theory of testing hypotheses. We may now summarize its aims as distinct from those of subjective theory, measuring the intensity of our belief by means of what is sometimes called inductive reasoning.

The theory of testing statistical hypotheses, as I understand it, is built up to deal with cases

- (i) Where previous experiments or observations have established that certain observable variables  $x_1, x_2, \dots, x_n$  can be looked upon as random

variables. The process of establishing this fact is perfectly analogous to, for example, establishing that, within a certain range of velocities, the resistance of the air to a moving body is proportional to its velocity, or to its square, or the like.

(ii) Where there are some unknown properties of the probability law of the variables  $x_1, x_2, \dots, x_n$ , the knowledge of which would influence some of our proposed actions. We had this in the above example where it was known that  $Y_2 = aa$ . The knowledge that for a particular  $Y_1$  the probability law of  $k$  is given by (5) would result in the breeder retaining this individual. Otherwise it would be discarded.

(iii) The most important point: where it is desired to *deduce* from the assumed and empirically checked properties of the observable variables, *what will be the relative frequencies* of the possible results of our actions considered, if those were based on the values of the  $x$ 's actually observed and would follow this or that rule.

Referring again to the above example, we may notice that the question asked by the breeder was: What will be the relative frequency of hybrids among the individuals which will be passed by his test? Another point that it may be useful to emphasize is that the frequencies of the results of our actions are to be *deduced* from the properties of the  $x$ 's. This is perfectly analogous to our deducing the range of a shot from the assumed knowledge of gravitation, the resistance of the air, etc., all provided by observation. Thus, it will be seen that the theory of testing hypotheses has no claim of any contribution to the "inductive reasoning."

12. In the light of what I have said just now, it will appear that the frequently bitter controversy about the problem of testing hypotheses, between the subjective and the classical school of thought, is based on a misapprehension. The application of the Bayes' formula and of its consequences, as advocated by Jeffreys, when the problem treated does not contain in its conditions the probabilities *a priori* interpretable in terms of frequencies, does not lead to results having any clear frequency interpretation. Instead it measures the "intensity of our belief." On the other hand, the theory of testing statistical hypotheses predicts relative frequencies—in so far as it is possible to do so—but does not claim to measure directly the confidence. If I am permitted to make a little joke, then I will compare a very strong recommendation of one of the methods as opposed to the other, to forcing on somebody the purchase of a pair of shoes when he actually feels in need of a tie, and when both are readily available.

13. We may now proceed to a more detailed discussion of the basic ideas of the theory of testing hypotheses. As it is convenient to carry on general discussions having in mind some illustrative example, it may be useful to mention that the example of the breeder discussed above is not a convenient one, and for the following reasons. First, it involves only one observable variable  $k$ , whereas in many other cases the number of such variables is greater, and this makes an important difference in the general situation. Next, the discussed example has the disadvantage that it involves only two admissible hypotheses: either  $Y_1 = Aa$  or  $Y_1 = AA$ . This limitation does not hold in a great number of cases treated by the theory of testing hypotheses, and the set of admissible hypotheses is usually infinite.

Finally the example that we have discussed is not typical because one of the two admissible hypotheses admits a crucial test. If the observable variable  $k$



Such a test may only consist in a rule to reject  $H_0$  in certain circumstances and to withhold such rejection (= to accept, for short) in others. Interpreting this rule geometrically, we may say that any test of a statistical hypothesis consists in a selection of a certain region,  $w_0$ , in the  $n$  dimensional experimental space  $W$ , and in basing our decision as to the hypothesis  $H_0$  on whether the experimental point  $E'$ , determined by the actual observations, falls within  $w_0$  or not. If it does, the hypothesis  $H_0$  will be rejected, if it does not, it will be accepted.

It will be convenient to label somehow the region  $w$  used for the above purpose and the term suggested [8] is the critical region.

We see that to choose a test means to choose the critical region and conversely.

Let us now consider more closely what could be the grounds for preferring one test to another. The obvious answer is that these grounds must be *the properties* of the tests considered. And if we think of what exactly should be understood by the "properties" of a test, we shall come to the conclusion that they must mean the relative frequencies with which a test rejects the hypothesis tested,  $H_0$ , (i) when it is true and (ii) when it is wrong.

We may describe this in another way, which was adopted in the early phases of the theory of testing hypotheses. There may be two possible outcomes of a test: either the hypothesis tested is rejected or it is accepted. Whichever may be the decision, it may be wrong. But as there are two different actions with respect to  $H_0$  which may result from the application of a test, there are two different ways in which we may be wrong, that is to say, two different kinds of errors that we may commit.

The labelling of them is a pure convention, but in the past we used to describe as the errors of the first kind those consisting in an unjust rejection of the hypothesis tested  $H_0$ . On the other hand, the error consisting in the failure to reject  $H_0$  when, in fact, it is incorrect, is called the error of the second kind.

With this terminology, to know the properties of a test means to know the probabilities of the errors of the first and of the second kind which may be committed when applying this particular test.

Recently [9] it was found convenient to introduce still another conception dealing with the same matter, that of a power function of a test.

Consider any critical region  $w$  and let

$$\beta(\theta_1, \theta_2, \dots, \theta_s | w_0) = P\{E \in w_0 | \theta_1, \theta_2, \dots, \theta_s\} \dots \dots (18)$$

be the probability of the experimental point  $E$  falling within  $w_0$ , as determined by some specified values of the parameters  $\theta_1, \theta_2, \dots, \theta_s$ . This probability, considered as a function of the  $\theta$ 's, the region  $w_0$  being fixed, is just what is called the power function of the test based on the critical region  $w_0$ , and it is easy to see the justification for this terminology. If we substitute  $\theta_1 = \theta_1^0$  in  $\beta(\theta_1, \theta_2, \dots, \theta_s | w_0)$  the result will be the probability of the experimental point falling within  $w_0$  in cases where the hypothesis tested is true. As the region  $w_0$  is to be used as the critical region, this will be also the probability of our rejecting (unjustly)  $H_0$  when it is in fact true, *i.e.*, the probability of an error of the first kind, calculated under the assumption  $H_0$ . On the other hand, if we substitute for  $\theta_1$  and value  $\theta_1'$ , different from  $\theta_1^0$ , the result will be the probability of rejecting  $H_0$  when it is false and  $\theta_1'$  instead of  $\theta_1^0$  is the true value of  $\theta_1$ . In other words, when we speak of the properties of a test based on the critical region  $w_0$ , all those properties are the properties of the power function  $\beta(\theta_1, \theta_2, \dots, \theta_s | w_0)$ , described so because

its values characterize what may be called "the power" of a test to detect the falsehood of the hypothesis tested. The comparison between, or the choice among two or more alternative tests can be rationally made only on the basis of their respective power functions.

15. We may now enter into some details of the problems arising with the study of power functions. These problems have an immediate bearing on the problems of application. In what has been said above you may have been a little surprised by the distinction made between the errors of the first and second kind. In fact, an error which is "of the first kind" when we test some hypothesis  $H_0$  becomes "of the second kind" when we test its negation, say  $\bar{H}_0$ , and conversely. The distinction in question is connected with the fact that in various problems of application the importance of one kind of error, whether we call it first or second, is by far greater than that of the other, and this must be taken into account when choosing the critical region.

Consider the following example. There are drugs which, in the process of manufacture are occasionally mixed with certain toxic materials. Before putting those drugs on the market, they are tested for toxicity. The test consists in giving certain doses of the drug to some experimental animals and in counting the survivors, the number of which will vary in accordance with the actual toxicity of the drug and with the individual susceptibility of the animals. This being variable from animal to animal, it is possible to commit both kinds of errors, to find that a really harmless batch of medicine is too toxic to be put on the market, or to let pass a preparation which is dangerous to the human life. Obviously it is the last of the two errors which is by far the more important, and when arranging the test it is natural to take the utmost care to have its probability as low as possible.

As it is more or less equivalent whether to consider that we are testing a hypothesis  $H_0$  or its negation  $\bar{H}_0$ , while the relative importance of the errors committed is determined by the very nature of the practical problem, some sort of permanent agreement as to what actually should be considered as the hypothesis tested appeared to be useful. A more or less general convention was adopted to consider as the hypothesis tested \* the one by which the errors of the first kind are of greater importance than those of the second. Thus in the above example of testing drugs, the hypothesis tested would be  $H_0$ : "the actual toxicity of the drug does exceed the prescribed safety limit," and the error of the first kind would be committed if (i) this hypothesis is in fact correct and (ii) if the test rejects it.

16. Having thus established a general desideratum that the probability of the errors of the first kind should be small, we immediately have a corresponding mathematical problem: to determine the critical region  $w_0$  so that the value of its power function at the point  $\theta_1 = \theta_1^0$  be small.

If the number of the unknown parameters is unity, then this problem is trivial. Whatever positive number  $\alpha$  we take, described as the "level of significance," it is always possible to find, usually an infinity of regions  $w$ , such that

$$P\{E \in w | \theta_1^0\} = \beta(\theta_1^0 | w) \leq \alpha \quad . \quad . \quad . \quad . \quad . \quad . \quad (19)$$

If the random variables considered are continuous, then it will be always possible to arrange for an equality in (19). Otherwise, we may have to be content with

\* For some reason, certain authors prefer the term "null hypothesis" to the original and seemingly more intelligible "hypothesis tested."

an inequality, with the result that when the hypothesis tested is correct, the probability of its being rejected will not exceed a number  $\alpha$  chosen in advance.

The problem under consideration is more interesting when the observable variables are continuous. So we shall limit our discussion to this particular case and describe all the regions satisfying the equality

$$P\{E \in w | \theta_1^0\} = \alpha \quad (20)$$

as equivalent and of "size"  $\alpha$ . But we shall consider this problem in the case where the number of unknown parameters  $s$  is greater than one. This case is obviously by far the more important, as it is only in exceptional practical cases that the number of unknown parameters involved in the probability law considered is equal to unity. Mostly there are several, and the hypothesis tested specifies the value of one of them only. This case is not only important from the practical point of view, but it is also very interesting theoretically, and brought up a mathematical problem which has not been considered before and even now has only partial solutions. It is as follows. If the probability law  $P\{E \in w | \theta_1, \theta_2, \dots, \theta_s\}$  of the observable variables involves  $s > 1$  unknown parameters, then, a region  $w$  being fixed, the substitution in  $P\{E \in w | \theta_1, \theta_2, \dots, \theta_s\}$  instead of  $\theta_1$  its value  $\theta_1^0$  specified by the hypothesis tested, does not necessarily determine uniquely the value  $P\{E \in w | \theta_1^0, \theta_2, \dots, \theta_s\}$  of the probability that the experimental point  $E$  will fall within  $w$ . In fact, this probability will generally depend on what the values of the other parameters are, and occasionally may vary from zero to unity. To see this it is sufficient to consider the variables (12) and (13) with the probability laws (14) and (15), which, on the assumption of the hypothesis tested  $\eta = 0$ , imply

$$P\{E \in w | \xi, \eta = 0, \sigma_1, \sigma_2\} = \left(\frac{1}{\sigma_1 \sqrt{2\pi}}\right) \left(\frac{1}{\sigma_2 \sqrt{2\pi}}\right) \iint_w e^{-\frac{\sum_{i=1}^{n_1} (x_i - \xi)^2}{2\sigma_1^2} - \frac{\sum_{i=1}^{n_2} (y_i - \xi)^2}{2\sigma_2^2}} dx_1 \dots dx_{n_1} \dots dy_1 \dots dy_{n_2} \quad (21)$$

If we choose  $w$  to be determined by the inequality

$$\sum_{i=1}^{n_1} x_i^2 + \sum_{j=1}^{n_2} y_j^2 \leq R^2 \quad (22)$$

where  $R$  is any positive number, then the value of (21) will vary between zero and unity, according to what  $\xi$ ,  $\sigma_1$  and  $\sigma_2$  are. If  $\xi = 0$  and both  $\sigma_1$  and  $\sigma_2$  are close to zero, then (21) will be as close to unity as desired. If, on the other hand,  $\xi = 0$  and both  $\sigma_1$  and  $\sigma_2$  are very large, then the value of (21) will be small.

It follows that the region determined by the inequality (22) is not suitable for use as a critical region for testing the hypothesis  $H_0$  that  $\eta = 0$ .

A similar situation arises always when the hypothesis tested is composite, and, if it is desired that the probability of the error of the first kind be equal to a specified value  $\alpha$ , we must look for a critical region  $w_0$ , such that, in spite of the probability law as specified by the hypothesis tested,  $P\{E \in w | \theta_1^0, \theta_2, \dots, \theta_s\}$  depending on  $s - 1 > 0$  unknown parameters  $\theta_2, \dots, \theta_s$ , its value for the region  $w_0$  is perfectly fixed and equal to  $\alpha$ , whatever be the values of  $\theta_2, \dots, \theta_s$ .

Such regions, satisfying the identity

$$P\{E \in w_0 | \theta_1^0, \theta_2, \dots, \theta_s\} = \alpha \quad (23)$$

for all values of the  $\theta$ 's within the admissible limits  $a_i < \theta_i < b_i$  for  $i = 2, 3, \dots, s$ ,



are called "similar" to the experimental space  $W$  with respect to the parameters  $\theta_1, \dots, \theta_s$ , and of size  $\alpha$ .

The introduction of the term "similar" is due to the fact that the experimental space  $W$  does satisfy the condition (23) with  $\alpha = 1$ .

Obviously, any region similar to the experimental space  $W$  with respect to all the parameters unspecified by the hypothesis tested and of a chosen size  $\alpha$ , will satisfy our requirements with respect to the control of the errors of the first kind. If we desire to deal with some optimum situation concerning the errors of the second kind, we shall have to make a choice between the different equivalent regions, similar to the experimental space. And I wish to call attention to the fact that, in order to be able to make a choice between the regions similar to  $W$  with respect to  $\theta_1, \dots, \theta_s$ , it is necessary to be able to construct not just a single region of this kind, but a family of them, preferably the family containing all such regions.

We have here, therefore, the following mathematical problems created by the theory of testing statistical hypotheses.

(i) Are regions similar to the sample space with respect to one or more parameters, of a size  $\alpha < 1$ , possible at all? The first affirmative answer to this question which at that time was not asked, is contained in the paper by Helmert [10], who has shown that, with the notation adopted in the example last considered and with  $\eta = 0$  and  $\sigma_1 = \sigma_2 = \sigma$ , the probability of  $E$  falling within the region  $w$ , determined by the inequality

$$\sum_{i=1}^{n_1} (x_i - m)^2 + \sum_{j=1}^{n_2} (y_j - m)^2 < \chi^2 \quad . \quad . \quad . \quad (24)$$

where

$$m = \frac{1}{n_1 + n_2} \left( \sum_{i=1}^{n_1} x_i + \sum_{j=1}^{n_2} y_j \right) \quad . \quad . \quad . \quad (25)$$

is equal to

$$P\{E \in w | \xi, (\eta = 0), (\sigma_1 = \sigma), (\sigma_2 = \sigma)\} =$$

$$\frac{1}{\sigma^{n_1+n_2-1} 2^{\frac{n_1+n_2-3}{2}} \Gamma\left(\frac{n_1+n_2-1}{2}\right)} \cdot \int_0^\chi t^{n_1+n_2-2} e^{-\frac{t^2}{2\sigma^2}} dt \quad (26)$$

As this probability is independent of  $\xi$ , it follows that the region defined by (24) is similar to the experimental space with respect to  $\xi$ . Later on many other examples of the same kind were found, but the one which attracted the attention to the problem is very much worth mentioning. It is that concerning the famous distribution of "Student" [11].

(ii) Are there cases where no region similar to the sample space exists? This question was recently answered affirmatively by the very elegant examples invented by Feller [12].

(iii) Given a probability law  $P\{E \in w | \theta_1^0, \theta_2, \dots, \theta_s\}$  depending on  $s-1 > 0$  unknown parameters  $\theta_2, \dots, \theta_s$ , what is the most general region  $w$ , similar to the experimental space  $W$  and of the size  $\alpha < 1$ ? Do such regions exist at all in this particular case?

This question is not yet answered in its full generality. Its first systematic study [13], in which the problem was first formulated, revealed the possibility of constructing the most general similar region only when the probability

law considered satisfies certain rather limiting conditions. Later on another method, [14], permitted the construction of a family of similar regions in a somewhat more general case, but still the answer to the question is very much incomplete.

(iv) An entirely untouched problem. In cases where no similar region exists, the necessity of reducing the probability of an error of the first kind requires a critical region  $w$ , for which the probability  $P\{E \in w | \theta_1^0, \theta_2, \dots, \theta_s\}$ , while being dependent on  $\theta_2, \dots, \theta_s$ , does not exceed a limit  $\alpha < 1$  fixed in advance. The problem is then to find the method of constructing all such regions if they exist.

I may mention that the problem of the similar regions, quite essential in the theory of testing statistical hypotheses is also of an extreme importance in the theory of estimation [15].

17. We may now turn to the question of the control of the second kind of errors, which was mentioned above in a somewhat vague form. In order to do so, we shall assume that for the probability law  $P\{E \in w | \theta_1^0, \theta_2, \dots, \theta_s\}$  the problem of similar regions has been solved, so that we have means of constructing any region  $w$  of a family,  $F$ , for which

$$P\{E \in w | \theta_1^0, \theta_2, \dots, \theta_s\} \leq \alpha \quad (27)$$

whatever be the  $\theta$ 's within the limits  $a_i < \theta_i < b_i$  for  $i = 2, 3, \dots, s$ . Thus all those regions of the family  $F$  will be, what we have called equivalent, of size  $\alpha$ . Out of this family  $F$  we have to choose one,  $w_0$ , the properties of which with respect to the control of the errors of the second kind would satisfy our requirements.

The first problem of this kind, the problem of the uniformly most powerful test, was formulated and solved in 1933 [13]. The definitions involved are as follows.

We say that a region  $w_0$ , belonging to the family  $F$ , is the most powerful critical region for testing the hypothesis  $H_0$  with respect to an alternative hypothesis  $H'$ , specifying the value of  $\theta_1 = \theta' \neq \theta_1^0$ , if, whatever be the values of  $\theta_2, \theta_3, \dots, \theta_s$ , and whatever any other region  $w$  of the family,  $F$ ,

$$P\{E \in w_0 | \theta_1', \theta_2, \dots, \theta_s\} \geq P\{E \in w | \theta_1', \theta_2, \dots, \theta_s\} \quad (28)$$

Again, if a fixed region  $w_0$  of the family  $F$  possesses the property of being the most powerful critical region for testing  $H_0$  with respect to any alternative hypothesis specifying any value  $\theta_1'$ , between the limits  $a_1 < \theta_1' < b_1$ , then we say that the region  $w_0$  is the uniformly most powerful region for testing the hypothesis  $H_0$  with respect to the whole class of alternative hypotheses for which  $a_1 < \theta_1 < b_1$ . The test based on such a region is called the uniformly most powerful test.

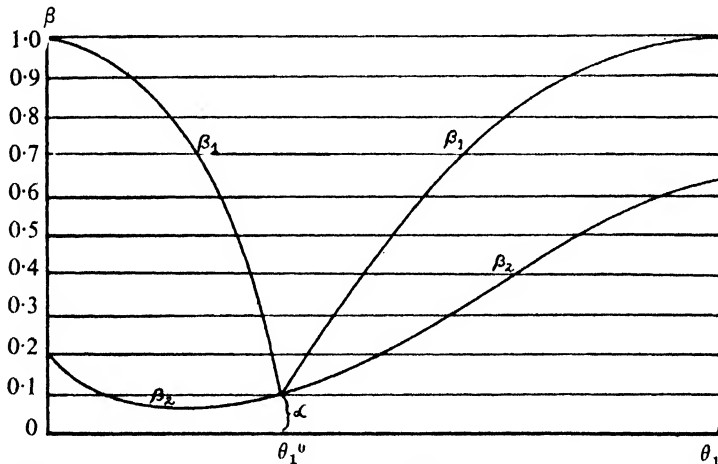
It is obvious that the conception of the most powerful test is a relative one. If the variability of  $\theta_1$  is limited to an interval  $a_1 < \theta_1 < b_1$ , such test may exist, but if  $\theta_1$  is allowed to vary within some broader limits, say from  $a_1' < \theta_1 < b_1$ , then any region  $w_0$  which is the most powerful with respect to the values of  $\theta_1$ , between the limits  $a_1 < \theta_1 < b_1$ , may fail (and frequently does fail) to possess this property with respect to all or some values of  $\theta_1$  between the limits  $a_1' < \theta_1 \leq a_1$ . Consequently, when speaking of the uniformly most powerful test of a given hypothesis  $H_0$ , it is essential to mention the set of alternatives with respect to which this hypothesis is tested. There is, of course, another source of the

relativity of the uniformly most powerful test which is present whenever the family  $F$  does not include all the equivalent regions similar to the sample space.

It is interesting to note that this question, whether a family  $F$  of similar regions that we are able to construct, includes all such regions or not, is connected with the unicity of solution of the problem of moments and hereby with some recent researches in the theory of quasi-analytic functions.

The properties of a uniformly most powerful test may be usefully illustrated using the conception of the power function. On the attached diagram the curves marked  $\beta_1 = \beta(\theta_1|w_0)$  and  $\beta_2 = \beta(\theta_1|w)$  represent respectively the graphs of the power functions of the uniformly most powerful critical region and of some other equivalent region, considered as functions of  $\theta_1$ , by fixed values of  $\theta_2, \dots, \theta_n$ . It will be seen that at  $\theta_1 = \theta_1^0$  the ordinates of both curves are the same, which corresponds to the condition that the regions are equivalent—that is to say, assure the same probability of the errors of the first kind. But, whatever other value of  $\theta_1 \neq \theta_1^0$ , the ordinate of the curve  $\beta(\theta_1|w_0)$  is greater than that of  $\beta(\theta_1|w)$ . In other words, in whatever way the hypothesis  $H_0$  may be wrong, the chance of detecting this fact is greater when using the region  $w_0$  than when using any other equivalent region  $w$  of the same family  $F$ .

18. As it may have been expected, it is only very rarely that the uniformly most powerful tests exist. A recent theorem [14] shows that when a certain amount of regularity of the probability law of the observable variables is coupled with the inequalities  $a_1 < \theta_1^0 < b_1$ , where  $a_1$  and  $b_1$  are the limits of possible values of  $\theta_1$ , then no uniformly most powerful test exists.



Graph of the Power Functions of a Uniformly Most Powerful Test and a Biased Test.

Thus, turning to the example concerning the variables (12) and (13) with the probability laws (14) and (15), in which it is assumed as known that  $\sigma_1 = \sigma_2$  and considering the problem of testing the hypothesis  $H_0$  that  $\eta = 0$ , it was possible to show [13] that there is a uniformly most powerful test of this hypothesis whenever the set of alternative hypotheses is limited to those for which  $\eta > 0$  (or  $\eta < 0$ ).

The corresponding critical region is determined by the inequality

$$t = \frac{y - x}{\sqrt{n_1 s_1^2 + n_2 s_2^2}} \sqrt{\frac{(n_1 + n_2 - 2)n_1 n_2}{n_1 + n_2}} > t_\alpha \quad . \quad . \quad . \quad (29)$$

where  $t_a$  can be conveniently taken from tables compiled by Fisher with his  $P = 2\alpha$  and his  $n = n_1 + n_2 - 2$ . Of course, this is the test proposed on intuitive grounds by "Student" and similarly generalized by Fisher [16].

However, its particular excellence in the case considered was possible to discover only on the ground of the general theory of testing hypotheses. Farther on we shall have another occasion to discuss this test.

As mentioned, the test based on the critical region (29) has the property of the uniformly most powerful test with respect to the class, say  $\Omega_1$ , of alternatives for which  $\eta > 0$ . The critical region determined by the inequality  $-t > t_a$  has similar properties with respect to another class,  $\Omega_2$ , of alternatives assuming that  $\eta < 0$ . However, if  $a$  and  $b$  are any numbers  $a < 0 < b$ , and if we consider a third class of alternatives  $\Omega_3$  for which  $a < \eta < b$ , then there will be no uniformly most powerful test of the hypothesis  $H_0$  with respect to this class  $\Omega_3$ .

19. The rareness of cases where a uniformly most powerful test exists leads to the necessity of looking for some other ways of specifying the problem of the control of the errors of the second kind. The idea originated from a case, where a graph of the power function of some particular test, which was actually calculated, exhibited features similar to those of the lower curve,  $\beta_2$  in above diagram. It will be seen that, on this graph, the values of  $\beta(\theta_1|w)$  corresponding to some values of  $\theta_1 < \theta_1^0$  are smaller than that corresponding to  $\theta_1 = \theta_1^0$ . Thus if for  $\theta_1 = \theta_1^0$  we have, says,  $\beta(\theta_1^0|w) = 0.1$ , then for those smaller values of  $\theta_1$  we may have, e.g.,  $\beta(\theta_1'|w) = 0.05$  or the like. The consequences of this fact, interpreted in terms of frequencies, would be as follows. If the critical region  $w$  was used for the actual test of the hypothesis  $H_0$ , then, in all those cases which may happen in practice where  $\theta_1 = \theta_1'$ , the hypothesis  $H$  that  $\theta_1 = \theta_1^0$  would be rejected with a relative frequency 0.05, thus more rarely than in cases where it is actually correct.

This property of the test, described as bias and likely to be considered unsatisfactory in many cases, led to the idea of looking for tests which would be free from it. The definitions involved are as follows [9]:

If the hypothesis tested,  $H_0$ , is simple and specifies the value  $\theta^0$  of a (unique) unknown parameter  $\theta$  involved in the probability law and if a region  $w_0$  possesses the properties

$$\left. \begin{array}{l} \text{(i) The first two derivatives of the power function exist,} \\ \text{(ii) } \left. \frac{d\beta}{d\theta} \right|_{\theta=\theta^0} = 0 \end{array} \right] \quad . \quad . \quad (30)$$

(iii) Whatever be any other region  $w$  equivalent to  $w_0$  and possessing the properties (i) and (ii),

$$\left. \frac{d^2\beta(\theta|w_0)}{d\theta^2} \right|_{\theta=\theta^0} \geq \left. \frac{d^2\beta(\theta|w)}{d\theta^2} \right|_{\theta=\theta^0} \quad . \quad . \quad . \quad . \quad . \quad (31)$$

then the region  $w_0$  is called the unbiased critical region of type  $A$ .

The almost obvious property of the region so defined is that its power function  $\beta(\theta|w_0)$  has a minimum at the value  $\theta = \theta^0$  specified by the hypothesis tested. In other words, this hypothesis will be rejected by the test based on  $w_0$  less frequently when it is true than when it is wrong. This, at least if the value of  $\theta$ , which happens to be true, does not differ very much from the one specified by the hypothesis tested. Another property of the test, due to the condition (iii), is

that, at least for values of  $\theta \neq \theta^0$  in the immediate vicinity of  $\theta^0$ , it is more powerful than any other test possessing the properties (i) and (ii).

The solution of the problem of finding the unbiased critical regions of type  $A$  and also of its generalization to the case where the number  $s$  of parameters involved in the probability law is greater than one, while the hypothesis tested specifies all of them, is fairly advanced [9].

Apart from the unbiased regions of type  $A$ , it appeared to be useful to distinguish those of type  $A_1$ , satisfying the following definition.

Under the general conditions where the unbiased regions of type  $A$  were defined, a region  $w_0$  is called an unbiased critical region of type  $A_1$ , if it possesses the properties

$$\left. \begin{array}{l} \text{(i')} \text{ The first derivative of its power function } \beta(\theta|w_0) \text{ exists} \\ \text{(ii')} \frac{d\beta}{d\theta} \Big|_{\theta=\theta^0} = 0 \end{array} \right] \quad (32)$$

(iii') Whatever be any other region  $w$  possessing the properties (i') and (ii') and equivalent to  $w_0$ , and whatever be the possible value of  $\theta = \theta' \neq \theta^0$ , always

$$\beta(\theta'|w_0) \geq \beta(\theta'|w) \quad (33)$$

Owing to the above properties it is suggested that the regions of type  $A_1$  should be called the uniformly most powerful ones out of all unbiased regions. It is obvious that their existence cannot be very frequent. Recently [9] it was possible to give a condition which is sufficient for this purpose.

In the case of simple hypotheses the problem of unbiased tests did not raise any essentially new mathematical problems. On the other hand, such a new problem appeared when the conception of the unbiased critical regions was applied to the case of a composite hypothesis, specifying the value  $\theta_1^0$  of one only of the two unknown parameters  $\theta_1$  and  $\theta_2$ , involved in the probability law. The definitions of the two kinds of unbiased critical regions, described now as of type  $B$  and  $B_1$  respectively, are quite analogous to those of types  $A$  and  $A_1$ . One obvious distinction is that instead of ordinary derivatives with respect to  $\theta_1$  of the power function, we have now to consider partial derivatives with respect to  $\theta_1$ , which is of no real consequence. But there is another distinction between the two cases and this proved to be important.

It will be noticed that, as the probability law of the observable variables considered here depends on two parameters,  $\theta_1$ ,  $\theta_2$ , the value of the derivative

$$\left. \frac{\partial \beta(\theta_1, \theta_2|w)}{\partial \theta_1} \right]_{\theta_1=\theta_1^0} \quad (34)$$

taken at  $\theta_1 = \theta_1^0$  will generally depend on that of  $\theta_2$ . Consequently, if we desire our test to be unbiased, independently of what might be  $\theta_2$ , we should ask that the corresponding critical region satisfies not just an equation, as in (32), but the identity in  $\theta_2$

$$\left. \frac{\partial \beta(\theta_1, \theta_2|w)}{\partial \theta_1} \right]_{\theta_1=\theta_1^0} \equiv 0 \quad (35)$$

Of course, the necessity of controlling the errors of the first kind to a specified level of significance would require that the critical region  $w$  should be similar to the sample space, *i.e.*, that

$$\beta(\theta_1^0, \theta_2|w) \equiv \alpha \quad (36)$$

for all possible values of  $\theta_2$ . The critical region of type  $B$  or  $B_1$  would be one of those satisfying (35) and (36), which also satisfies the obvious modification of the conditions (31) or (33) respectively. It follows that, to find such a region, we are compelled to look for a family of all, or, at least, of some regions satisfying (35) and (36). Such regions may be labelled bi-similar to the sample space with respect to the parameter  $\theta_2$ .

Admitting certain rather limiting conditions concerning the probability law of the observable variables, the problem of determining the most general bi-similar regions was solved first for the case just considered, where the number of parameters unspecified by the hypothesis tested is equal to one [17]. Later on these results were generalized by Sato [18] for the case where the number of parameters unspecified by the hypothesis tested is arbitrary. In spite of these results, the problem of bi-similar regions requires further work, even more than that of similar regions.

20. Apart from the independent theoretical interest that the above developments may possess, it must be clear that they have a considerable handicap, which as a matter of fact affects a very broad domain of the present statistical theory known as the theory of small samples. It is true that this handicap does not affect the theory itself, but only its applications. But as the theory grows out of problems of applications and, at least partly, for their sake, the handicap in question is serious.

We are able at present to recognize whether in a particular case, say, a uniformly most powerful test exists or not, and we are able to construct it. The same partly applies to other tests described above. But for all this to be possible, the particular case in question must be rather accurately described. In other words, the applications of many chapters of the theory of testing statistical hypotheses require a very considerable knowledge of the properties of the observable variables. This is a great disadvantage, because in the majority of applicational problems our actual knowledge of the observable variables is very limited.

We do frequently know some of these properties for certain—namely those which depend on the method of observing the variables, or the method of experimentation. But then there usually remain very many factors, which are unknown and which make the application of the theory rather difficult.

The elements concerning the observable variables which are frequently known are such as their mutual independence, due to some particular method of experimentation. Alternatively we may know that some or all of the observable variables are mutually dependent, and we may even know some characteristics of this dependence. Thus it was possible to calculate the correlations existing between the single observations in certain methods of agricultural trials such as Randomized Blocks and Latin Squares [17]. But this does not give us enough knowledge of the actual probability law of those variables, and the best we can do to apply the theory is to postulate that the variables in question are, say, normally distributed with correlations as calculated from the knowledge of the particular method of experimentation. The results [20] obtained in this way are of considerable interest and importance, but they do depend on the assumption of normality, which, probably, is not always satisfied.

To deal with this sort of difficulty two different methods were advanced. The first, a very brilliant one, is due to Fisher, and is commonly known as the method of randomization [21]. As the author of this method is scheduled to

speak during this Conference, I need not enter into the details, but briefly the method is based on the following idea.

The method is applicable always when the hypothesis tested implies the symmetry of the probability law either of the observable variables directly or of some of their transformations. We shall have an example of such symmetry if the hypothesis tested assumes, among others, that each of the observable variables  $x_1, x_2, \dots, x_n$  follows the same probability law and is independent of the others. But this is no more than an example. Without assuming the mutual independence, we shall further consider, for simplicity, the case where the symmetry applies directly to the probability law of the observable variables.

Whatever be the other properties of the probability law specified by the hypothesis tested, it is obvious that, on this hypothesis  $H_0$ ,

$$P\{x_1 \leq x_2 \leq \dots \leq x_n | H_0\} = P\{x_2 \leq x_1 \leq x_3 \leq \dots \leq x_n | H_0\} = \text{etc.} = P\{x_n \leq x_{n-1} \leq \dots \leq x_1 | H_0\} \quad (37)$$

which is a direct consequence of the assumed symmetry of the probability law of the  $x$ 's. Denote by  $a_1, a_2, \dots, a_n$  any permutation of the integers  $1, 2, \dots, n$ . As the  $x$ 's are certain to satisfy one of the  $n!$  inequalities

$$x_{a_1} \leq x_{a_2} \leq \dots \leq x_{a_n} \quad (38)$$

if the probability law of the  $x$ 's is continuous, then, whatever be the actual permutation  $a_1, a_2, \dots, a_n$ , the probability

$$P\{x_{a_1} \leq x_{a_2} \leq \dots \leq x_{a_n} | H_0\} = 1/n! \quad (39)$$

and it follows that any of the regions  $w(a)$  determined by the inequalities

$$x_{a_1} < x_{a_2} \leq \dots \leq x_{a_n} \quad (40)$$

is similar to the sample space with respect to anything which the hypothesis tested may fail to specify. I repeat, the only condition for this is that the probability law of the  $x$ 's, as specified by the hypothesis tested, should be symmetrical with respect to all the  $x$ 's.

Consequently, taking as critical regions either a single region of the type of  $w(a)$ , or a sum of several such regions, or a certain combination of parts of a few such regions properly chosen, we may obtain a critical region of a definite size, reducing the probability of the error of the first kind to a level  $\alpha = k/n!$ , with an integer  $k \leq n!$ , which it is possible to choose in advance. As far as I am aware, no systematic study of the methods by which to obtain a critical region with the greatest power has yet been made. The tests are advanced on intuitive grounds. They usually refer to the case where the  $n$  observable variables fall into two or more groups of observations and the hypothesis tested implies that there is no real differentiation between the conditions in which these observations are made.

Essentially the same idea as described above lies behind the brilliant test of independence recently advanced by Hotelling and Pabst [22].

It was assumed for some time that the application of tests based on the principle of randomization implies the same arithmetical procedure as the well-known tests of the analysis of variance. This question was recently discussed in two interesting studies by Welch [23] and Pitman [24], and was answered in the negative, though the actual differences do not seem to be very great.

As mentioned, no systematic study of the power functions of the randomiza-

tion tests is yet available. One particular case was recently examined by Pearson [25], and the results seem to indicate that, at least in some cases, the power of such tests may be rather poor.

21. Another method of attack on the same difficulty, connected with too great a lack of knowledge of the actual properties of the observable random variables, is based on the following idea.

Consider a sequence of random variables  $x_1, x_2, \dots, x_n$ , the particular values of which may be given by independent observations. Assume that, as is frequently the case, we know but very little about the probability law that these variables may follow. It is known, however, that if we consider not the single variables, but certain functions of these variables, such for example as their arithmetic means, then frequently we can predict the probability law that those functions will follow and the prediction will be valid practically in all cases likely to be met with in practice, under the sole restriction that the number of the variables be at least moderately large. Thus if we take some  $n = 50$  or more independent observations  $x_1, x_2, \dots, x_n$  of practically any variable that a real statistical problem may involve, its mean is bound to follow a normal law with a degree of accuracy that will be certainly generally considered as adequate. A recent work [26] implies that this is true for a broad class of functions, besides the mean.

The known facts of this kind suggest the idea of tests of statistical hypotheses which, when the number  $n$  of observations is very small will have some unknown properties, but which will have any desired properties, so to say, in the limit, when  $n$  is indefinitely increased. Accordingly, for example, we may think of tests which will be unbiased in the limit.

It is obvious that the development of such tests depends on the so-called limit theorems of the theory of probability. One class of such theorems connected with the names of Liapounoff and S. Bernstein [27] was actually used. The results [28], [29], [30] are encouraging, but it seems that the limit theorems applied, using effectively only the moments of the observable variables of two first orders, are not sufficiently strong. Probably better results would be obtained on the basis of asymptotic expansions in terms of higher moments, of the kind that one finds in the excellent recent book of Cramér [31].

22. It is obvious that no review of the recent advances in a particular field, given in a single conference, can be complete. Consequently also this particular account is of necessity very incomplete. But before concluding the discussion of what may be called the general theory of testing statistical hypotheses I should like to call the attention to an excellent paper by Wald, read before the Institute of Mathematical Statistics during its meeting in Detroit in December 1938, an abstract of which is already published [38].

It deals with the points of view which are new in many respect. One of them is that the selection of a critical region should not depend on the properties of the power function in the vicinity of the values specified by the hypothesis tested, but, as in the case of uniformly most powerful tests, on the properties of the power function considered over the whole range where it is defined. The problem is made precise by introducing a weight function representing the "loss" which will be incurred by accepting the hypothesis that  $\theta = \theta^0$  when actually  $\theta = \theta' \neq \theta^0$ .

23. Up to the present time I have tried to give an account of what could be considered a general theory of testing statistical hypotheses. As mentioned, an



account like this cannot be complete: I had to make selections, and naturally they are influenced by my personal interests. Now, when attempting to make some review of various particular problems, I shall have again to select them, and be even more incomplete than while sketching the progress of the general theory. The amount of various particular problems that are being worked out by different authors is simply enormous. All I can do is to mention a few of the results and to select them from those which stand in a certain relationship to, and are good illustrations of the theory discussed above. It should be, therefore, understood that an omission of some particular result does not mean a lack of its appreciation on my part.

We may perhaps start by explaining the distinction made between a result of the general theory and that concerning a particular problem. The distinction is not very sharp and, probably, depends on one's perspective of what is actually being done. To the general theory of testing hypotheses I refer everything that is concerned with the basic conceptions of this theory and with their properties in some broad categories of cases. Thus the theorem concerning the conditions sufficient for the non-existence of the uniformly most powerful tests is certainly a part of the general theory. So is the theorem specifying the sufficient conditions for an unbiased test of type  $A$  to be also of type  $A_1$ , etc. On the other hand, if we take a well-specified case, for example where we may observe the  $n_1 + n_2$  variables (12) and (13) known to be following the laws (14) and (15) and ask about the power function of the test determined by the inequality (29), then we shall have a particular problem.

I should like to emphasize that this distinction does not imply any difference in appreciation that I attach to progress in general theory and in working out particular problems. Both kinds of problems may be of varying importance and difficulty, and, if a distinction is made at all, it is for the sake of a certain perspective on the whole structure of our subject.

As a matter of fact, from the point of view of applications, it seems that many particular problems have a rather greater importance.

Referring again to the variables (12) and (13) and to the hypothesis  $H_0$  assuming  $\eta = 0$ , if it is known for certain that  $\sigma_1 = \sigma_2$ , the results of Sato [16] already referred to, imply that the test determined by the inequality

$$|t| > t_\alpha \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (41)$$

where  $t$  and  $t_\alpha$  are as in (29) with Fisher's  $P = \alpha$ , is an unbiased test of type  $B_1$ , that is to say, a uniformly most powerful test out of all those which are unbiased. Obviously it would be difficult to over-estimate this particular result, showing that, in the conditions considered, it would be useless to try to make any improvement on the power of the test. These conditions are: all the  $n_1 + n_2$  random variables  $x_i$  and  $y_j$  are mutually independent and follow normal laws, with unknown means  $\xi$  and  $\xi + \eta$  respectively and with the same, though unknown, standard deviations,  $\sigma_1 = \sigma_2$ .

Now I am going to mention another particular result concerning the same test (41) but referring to another set of conditions. This result was first found in an approximate investigation by Welch [33], and then rigorously proved by Hsu [34]. The latter work was made possible by a remarkable theorem of Cramér [31] concerning the probability law of a ratio of two independent variables.

The set of conditions in which it was suggested to use the test (41) and which

was studied by Welch and Hsu is as follows. It is assumed as known that the variables  $x_1, x_2, \dots, x_{n_1}$  and  $y_1, y_2, \dots, y_{n_2}$  are all mutually independent and follow the normal laws (14) and (15) with unknown means  $\xi$  and  $\xi + \eta$ , and with also unknown standard deviations  $\sigma_1$  and  $\sigma_2 = \sigma_1\sqrt{\theta}$ , where  $\theta$  denotes any positive number. The hypothesis to test is then  $H_1$ , that both  $\eta = 0$  and  $\sigma_1 = \sigma_2$ , so that  $\theta = 1$ . It appears that the power function of the test (41) depends on two variables  $\theta$  and  $\lambda = \eta^2/2\sigma^2$ , where  $\sigma^2 = (\sigma_1^2/n_1) + (\sigma_2^2/n_2)$ . We shall denote it by  $\beta(\lambda, \theta)$ . Geometrically  $\beta(\lambda, \theta)$  would be adequately represented by a surface. This being difficult to represent on a diagram, we shall illustrate the results of Hsu and Welch first by giving numerical values of the power function  $\beta(\lambda, \theta)$  corresponding to  $\lambda = \eta = 0$  and to varying values of  $\theta$ .

TABLE II.  
*Values of  $\beta(0, \theta)$ . Level of significance  $\alpha = 0.05$*

$\theta$	0	0.02	0.05	0.10	0.20	0.50	1	2	5	$\alpha$
$n_1 = 15$ $n_2 = 5$	0.0024	0.0028	0.0032	0.0049	0.0084	0.025	0.05	0.098	0.178	0.317

It is seen that the  $t$ -test, as applied to the hypothesis  $H_1$ , is distinctly biased: The hypothesis tested may be seriously wrong, with the value of  $\theta$  equal to a small fraction instead of unity, and then the chance of the hypothesis tested being rejected will be considerably smaller than in the case where it is actually true. Thus, if the hypothesis tested is true and  $\theta = 1$ , the chance of this hypothesis being rejected by the test is  $\alpha = 0.05$ . On the other hand, if the hypothesis  $H_1$  is wrong and  $\theta$  happens to be equal, say, to 0.10, the chance of  $H_1$  being rejected by the test is only 0.0049, etc., and as a matter of fact, the further is the true value of  $\theta$  from the hypothetical  $\theta = 1$ , in one direction, the smaller is the probability of the falsehood of the hypothesis being detected. This fact alone would probably be sufficient to reject the method considered as a means of testing the hypothesis  $H_1$ . But it may be useful to point out that the presence of the above bias is not limited to the case where  $\eta = 0$ . Thus, for example, Hsu has shown that for  $n_1 = 60$ ,  $n_2 = 30$ ,  $|\eta| = 2.6$  and  $\sigma_2 = 1$ , the probability of the hypothesis  $H_1$  being rejected by the test tends to 0.006 when  $\sigma_1 \rightarrow \infty$ . On the other hand, if the hypothesis tested was true, the chance of its rejection would be again  $\alpha = 0.05$ . Therefore, as far as we are concerned with the hypothesis  $H_1$ , assuming that both  $\eta = 0$  and  $\sigma_1 = \sigma_2$ , the  $t$ -test is more or less useless.

I give these details concerning one particular situation, out of the several analogous ones studied by the two authors, in order to emphasize the importance of their own investigations and of the investigations of power functions in general. They may help to destroy some of the unfounded beliefs which are occasionally established by the somewhat dogmatic tone of certain sections of the modern statistical literature. Thus, in a popular book on statistical methods we find the following passage referring to the  $t$ -test as applied to the hypothesis  $H_1$  just discussed.

"It has been repeatedly stated, perhaps through a mis-reading of the last paragraph, that our method (the  $t$ -test as described above.—J. N.) involves the 'assumption' that the variances are equal (*i.e.*, that  $\sigma_1 = \sigma_2$ .—J. N.). This is

an incorrect form of statement; the equality of the variances is a necessary part of the hypothesis to be tested, namely that the two samples are drawn from the same normal population. The validity of the  $t$ -test, as a test of this hypothesis, is therefore absolute, and requires no assumption whatever."

The author of this passage does not explain what exactly he means by his "validity of the  $t$ -test is absolute," and it is possible that what he meant to say does not imply anything conflicting with the results of Hsu and Welch. But there is little doubt that the above passage must be frequently interpreted as a strong recommendation to use the  $t$ -test in order to discover differentiation between the two populations sampled, and to use it always, whether it is known that  $\sigma_1 = \sigma_2$  or not. In the light of this, it is certainly a great convenience to know that

(i) If it is known that  $\sigma_1 = \sigma_2$  and  $\eta$  happens to be different from zero, then the application of the  $t$ -test gives the greatest probability of detecting this last circumstance, and that it would be useless to try to increase this probability by applying any other equivalent test.

(ii) If, however, the equality  $\sigma_1 = \sigma_2$  is doubtful and the samples available are of different size, while it is desired to test the hypothesis  $H_1$  that both  $\eta = 0$  and  $\sigma_1 = \sigma_2$ , then there may be situations where the hypothesis tested is very wrong and the chance of the  $t$ -test detecting this circumstance absolutely minute.

(iii) If the equality  $\sigma_1 = \sigma_2$  is doubtful, the sizes of the two samples are different and the hypothesis tested  $H_2$  assumes only that  $\eta = 0$ , while totally ignoring the  $\sigma$ 's, then, as is implied by the Table II, the  $t$ -test fails to control even errors of the first kind, the probability of which may vary within very broad limits. While this is also true with respect to another test,  $u_2$ , also discussed by Hsu and Welch, the latter appears to be somewhat less unsatisfactory than the  $t$ -test.

(iv) If the sizes of the two samples are equal and not very small, then the  $t$ -test, as applied to the hypothesis  $H_2$ , appears to be satisfactory.

All these are the results of the inquiries quoted above, and it may be hoped that they will help to obviate the various misconceptions concerning the  $t$ -test which may have become established.

24. The study of the power functions of tests is useful not only in those cases where it is desired to form an appreciative opinion of one or more tests. The tables of the actual values of the power functions are frequently of great importance even then, when it is actually known that a given test could not be possibly improved, *e.g.*, when it is a uniformly most powerful test.

The first table of this kind was calculated by Kołodziejczyk [35] and partly published in the *Comptes Rendus*. The full tables appeared in a joint publication already referred to [19]. After a time it appeared that Kołodziejczyk's tables could be usefully rearranged, which required another publication [36]. All those tables refer to the same  $t$ -test discussed above, as applied to the hypothesis that  $\eta = 0$ , where it is known that  $\sigma_1 = \sigma_2$  and that the alternatives are limited to  $\eta > 0$ .

The practical problems for the solution of which these tables are useful are the problems of planning experiments, the results of which are to be analyzed by means of the  $t$ -test as described above. Any such experiment, arranged for the purpose of testing whether some  $\eta$  is actually equal to zero or not, should

be planned so as to have a reasonable chance of detecting that  $\eta$  is different from zero if this is in fact true, and if the size of  $\eta$  is considerable. This chance, actually the value of the power function of the test, appears to depend on certain properties of the experiments, of which we must have some knowledge to be able to apply the tables. Among others it depends on the number of observations to be made, as compared with the number of different questions that the experiment is supposed to answer. In recent years there appears to be a tendency to arrange the experiments, agricultural and others, so that, by a more or less fixed number of observations to be made, the number of questions asked should be as great as possible. The guiding principle of this was that Nature is likely to give much more intelligible answers if it is given a properly worked out questionnaire instead of a single question. As a result of this general tendency we sometimes witness experiments laid out with the view of answering so many questions that the number of observations per question becomes alarmingly small. In such cases it is well to ask the following question. The experiment to be carried out is designed, among others, to test whether a certain  $\eta$  is equal to zero. By applying the  $t$ -test to the future experimental results and using the level of significance, say  $\alpha = 0.05$ , we can make sure that the probability of our stating wrong that  $\eta > 0$ , when in fact it is equal to zero, will be equal to 0.05. But now suppose that  $\eta$  is not zero, but has a positive value which, from practical considerations, could not be regarded as negligible. What will be then the probability of the experiment and the  $t$ -test discovering this circumstance?

Provided we have sufficient knowledge about the general conditions of the experiment planned, the above question can be answered by means of the Kołodziejczyk's tables. An analysis on these lines of a number of actual experiments, the descriptions of which appear from time to time in the literature, seems to indicate that if, before carrying out the experiments, their design was studied from the above point of view, it would probably have been altered. The gain or loss in yield of about 10 per cent. of the average yield of the objects studied in agricultural experiments is certainly something to worry about. And then it was found that in some agricultural trials the probability of detecting such differences is under 0.08.

A set of tables of a power function, similar to those of Kołodziejczyk, but by far more extensive and, probably, more important, was recently published by Tang [37]. The power function tabled is that of the test of general "linear hypothesis" as discussed by Kołodziejczyk [38] and Welch [39]. The test derived reduces to the well-known Fisher's  $z$ -test [40]. Tang's paper contains eight pages of tables and gives examples of their application in estimating the efficiency of such experimental designs as Randomized Blocks and Latin Squares. His work was well prepared by the previous excellent results of Fisher [41], Wishart [42] and others. In time the tables of Tang will probably become a general basis for a rational planning of experiments, intended to discover differentiation between more than two objects compared. Apart from this, as it was shown by Hsu [43], the same tables of Tang could be used to calculate the power of the remarkable  $T$ -test, advanced by Hotelling [44]. In the same paper of Hsu we find a very interesting theorem showing a certain optimum property of the Hotelling's  $T$ -test. It appears, in fact, that this test, at least with respect to the alternatives not very different from the hypothesis tested, is more powerful than any other test belonging to a certain broad class  $D$ .

By far the most extensive tables of those recently published and having a

direct application to the problems of power functions, are the tables of the ordinates and the probability integral of the correlation coefficient, calculated by Miss F. N. David. The idea of those tables was originated by Karl Pearson long ago, and then it took Miss David quite a number of years to calculate them. The book is very nicely issued by the Biometrika Office, and contains a good explanatory introduction and useful charts [45].

Two more papers dealing with power functions should be mentioned. One [46] is by Jackson and deals with the interesting case where there is only one observable variable, while the set of hypotheses alternative to the one that is tested is discontinuous. This case presents many features which do not exist in the continuous cases discussed above. The other paper [47] is by Wilks and Miss Thomson, and is concerned with the power function of a “ $\lambda$ -test” applied to the hypothesis assuming that the standard deviations of  $k$  sampled populations, known to be normal, are all equal. As the  $\lambda$  test deduced for a little more comprehensive hypothesis, that all the  $k$  sampled populations are identical, presents many similar features, it may be hoped that the method used by Wilks may give some results also in this case.

25. When studying power functions of tests relating to the so-called “large samples theory,” that is to say such, the theory of which involves some passage to the limit, we have to face special difficulties.

In order to explain in what exactly they consist I shall discuss in some detail one of the particular problems which has been recently treated, that of the power function of the K. Pearson’s  $\chi^2$ -test, as applied to a simple hypothesis: Let the probabilities of  $s$  different outcomes of a given experiment, specified by the hypothesis tested  $H_0$ , be  $p_1^0, p_2^0, \dots, p_s^0$ . The experiment is independently repeated  $N$  times, and  $m_i$  represents the number of occurrences of the  $i$ th outcome  $E_i$ . As is well known, the  $\chi^2$  test consists in the rule of rejecting  $H_0$  whenever

$$\chi^2 = \sum_{i=1}^s \frac{(n_i - Np_i^0)^2}{Np_i^0} \geq \chi_a^2 \quad . \quad . \quad . \quad . \quad . \quad (41)$$

where  $\chi_a$  is a suitable constant, taken from the Elderton’s or Fisher’s tables [49], [50], [40], in accordance with the chosen level of significance.  $\alpha$ . Whether the hypothesis tested is true or not, the probability of the experimental point falling within the critical region determined by (41) is represented by a sum of familiar multinomial terms. This sum by itself is difficult to manage, and consequently we are compelled to use some asymptotic processes. If the hypothesis tested is true and  $N$  is increased, then, as is well known, the probability of the fulfilment of (41) tends to the integral

$$c \int_{\chi_a}^{\infty} \chi^{5-2} e^{-\chi^2} d\chi = \alpha \quad . \quad . \quad . \quad . \quad . \quad (42)$$

and one is tempted to study the power function of the test by means of a similar passage to the limit. This, however, if attempted without any special device, fails. In fact, if the hypothetical  $p_1^0, p_2^0, \dots, p_s^0$  are not the true probabilities of the different outcomes of the experiments considered, then as  $N \rightarrow \infty$ , the probability of the inequality (41) tends to unity.

One of the possible devices to avoid the difficulty of this kind has been used, among others, by Eisenhart. He studied the problem just mentioned, that of the power function of the  $\chi^2$ -test. It is hoped that his results [49] will be soon published in full in the *Annals of Mathematical Statistics*. A short abstract of

the paper already appeared in print [50]. Among others, this work of Eisenhart will permit the comparison of the  $\chi^2$ -test with the competitive "smooth" test for goodness of fit, for which also a limiting form of the power function is available [28]. Unfortunately it is not yet known how well those limiting forms apply, when the number of observations is only moderate. With respect to the power function of the "smooth" test, I have the feeling that probably we shall have to look for a better approximation.

When speaking of the tests for goodness of fit, it may be useful to mention that a new test of this kind, devised by Fisher and Karl Pearson, [40], [53], is not based on any sort of passage to the limit, and that E. S. Pearson discovered [54] that, at least with respect to a limited set of alternatives, it has the property of being uniformly most powerful.

26. After this somewhat long journey, having in view to sketch the recent developments of what I call the theory of testing statistical hypotheses, it may be well to go back to where we have started, and to add a few remarks concerning the controversy of the subjective versus classical points of view on tests. In particular, I should like to comment on some arguments against the theory of testing hypotheses that I had occasions to hear. They are more or less as follows.

The theory of testing statistical hypotheses, as opposed to the subjective method of measuring the degree of our belief in these hypotheses, is supposed to give some results concerning the hypotheses tested, which are to be interpretable in terms of frequencies. In the case of the example with the breeder, it was possible to give the relative frequency of his successes in selecting dominant organisms. But the same result would have been obtained by the subjective school also. Therefore, it would be interesting to know whether the theory of testing statistical hypotheses could answer the question similar to that in the case of the breeder in such circumstances where its results differ from those of the subjective theory. More specifically:

(i) If we take any of the examples discussed above where any hypothesis  $H_0$  is being tested, without the *a priori* probabilities being known, is the theory able to say how frequently shall we be wrong or correct in applying this or that test?

(ii) If this question is to be answered in the negative, then would not it be equivalent to the admission that ultimately the application of the various tests rests upon some sort of "degree of confidence," perhaps based on some new principle?

(iii) And if so, then what is wrong in the principles of the subjective theory?

*Of course* the answer to the question (i) is negative. To give an affirmative answer to this question would be equivalent to a denial of the correctness of the Bayes' formula. Without knowing how frequently we shall have to deal with any of the admissible hypotheses, we are not able to say how frequently we shall be right in dealing with them according to this or that rule. This may be considered unfortunate, but we cannot help it, and have simply to face the fact.

But a negative answer to the question (i) does not imply an affirmative answer to question (ii). Without any knowledge of how frequently we shall have to deal with cases where some particular admissible hypotheses  $H_0$ ,  $H'$ ,  $H''$ , etc., will happen to be true, we expect that they will be true occasionally.

In particular, we expect the hypothesis tested  $H_0$  to be true from time to time and, as practical considerations make it very undesirable that it should be rejected when true, we arrange our test accordingly: so that the probability of the first kind of errors, given  $H_0$ , be equal to  $\alpha$ , a number that we choose ourselves. This result has a very clear frequency interpretation.

An attempt to test  $H_0$  implies two things: (a) the admission that an alternative hypothesis may be true instead of  $H_0$ , and (b) a desire not to accept  $H_0$  when the true hypothesis is some  $H'$ , different from  $H_0$ . Accordingly, while keeping the probability of the errors of the first kind fixed, we try to arrange our test so as to have the greatest frequency of rejections of  $H_0$  when the alternative  $H'$  is true. We also try to calculate those frequencies, represented by the power functions. And again there is no question of any sort of measuring of the intensity of our belief.

We may now turn to the question (iii). There is nothing wrong in the principles of the subjective theory, at least I do not see anything wrong in them. But when applying these principles and calculating formulae some elements of which are measures of our belief, without having any frequency interpretation, we must be clear that our results will be of the same kind. Therefore, if in a particular case it is desired to obtain a result which does have a frequency interpretation, then in this case the tests of the subjective theory become inapplicable, and we have to look for something else.

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#### APPENDIX

1. The pages printed above are exactly as they were written during the summer of 1939 and presented at the Conference at Geneva. Since that time many important publications have appeared that are not mentioned here, merely or the reason of the dates of their publication. The purpose of the present Appendix is to mention two such publications, or, rather, two small sections of them, that have a direct bearing on the questions discussed. Chronologically the first of these is the book, *Theory of Probability*, by Harold Jeffreys, Oxford, 1939, pp. vi + 380. The second is an article by R. A. Fisher, "The Asymptotic Approach to Behrens's Integral, with Further Tables for the d Test of Significance," *Annals of Eugenics*, Vol. 11 (1941), pp. 141-72.

2. As mentioned in the early sections of the main text of this paper, Dr. Jeffreys ranks among the most radical proponents of the subjective theory of probability. If anything, his new book presents an increase in his radicalism. He goes so far (p. 300) as to claim that no consistent theory of probability is possible without the basic notion of degrees of reasonable belief. His further contention is that the proponents of theories of probabilities alternative to his own forget their definitions "before the ink is dry" (p. 303). In Jeffreys's opinion they use the notion of reasonable belief, usually without ever noticing that they are using it, and by so doing contradict the principles that they have laid down at the outset.

The necessity of any given axiom in this or that mathematical theory is something that is subject to proof. For example, it was possible to prove that many theorems of calculus that were taught for many years in universities depend on the famous axiom of Zermelo, which by itself seems to be very doubtful to many mathematicians. The method of proof is as follows: one assumes that a given theorem is true and then deduces that the axiom that is subject to doubt must be true also.

However, Dr. Jeffreys's contention that the notion of degrees of reasonable belief and his Axiom 1 are necessary for the development of the theory of probability is not backed by any attempt of proof. On the other hand, he considers definitions of probability alternative to his own and proceeds to show by examples that, if these definitions are adhered to, then the results of their application would be totally unreasonable and unacceptable to anyone. Some of the examples are striking, and it seems to be useful to consider briefly at least one of them. Dr. Jeffreys writes (p. 300):

"The first definition is sometimes called the 'classical' one, and is stated in much modern work, notably that of J. Neyman,"

This definition reads:

"If there are  $n$  possible alternatives, for  $m$  of which  $p$  is true, then the probability of  $p$  is defined to be  $m/n$ ."

"The first definition appears at the beginning of De Moivre's book (*Doctrine of Chances*, 1738). It often gives a definite value to a probability; the trouble is that the value is one that its user immediately rejects. Thus suppose that we are considering two boxes, one containing one white and one black ball, and the other one white and two black. A box is to be selected at random and then a ball at random from that box. What is the probability that the ball will be white? There are five balls, two of which are white. Therefore, according to the definition, the probability is  $2/5$ . But most statistical writers, including, I think, most of those that professedly accept the definition, would give  $(1/2) \cdot (1/2) + (1/2) \cdot (1/3) = 5/12$ . This follows at once on the present theory, the terms representing two applications of the product rule to give the probability of drawing each of the two white balls. These are then added by the addition rule. But the proposition cannot be expressed as the disjunction of 5 alternatives out of 12. My attention was called to this point by Miss J. Hosiasson."

Actually the definition that is used in my own publications is different from that quoted by Dr. Jeffreys. It requires more words, and the above passage seems to suggest that these additional words are necessary.

As explained elsewhere [7], [14], the word "probability" is used by me only in one connection: probability of an object  $A$  having a property  $B$ . This is denoted by  $P\{B|A\}$ . Occasionally, of course, the above phrase seems too long, and various abbreviations are both possible and useful. But while using one it is necessary to remember that it is an abbreviation. The above phrase is preferred to others because it tends to emphasize the relative character of the conception of probability referring to the *set* of such objects that satisfy the definition of  $A$ . To emphasize the importance of this fact the set of all objects  $A$  is given a special name, the fundamental probability set (F.P.S. for short). It is also emphasized that, before treating any problem, one should get clear about the F.P.S. to which the probability sought has to refer and about the properties of this set that are implied by the condition of the problem. In the simple case, where the F.P.S. is finite,  $P\{B|A\}$  is defined as the ratio

$$P\{B|A\} = \frac{\text{no. of all those objects } A \text{ that possess property } B}{\text{no. of all objects } A}.$$

In the particular example of Dr. Jeffreys the objects  $A$  are obviously not balls, but pairs of random selections, the first of a box and the second of a ball. If we like to state the problem without dangerous abbreviations, the probability sought is that of a pair of selections ending with a white ball. All the conditions of there being two boxes, the first with two balls only and the second with three, etc., must be interpreted as picturesque descriptions of the F.P.S. of pairs of selections. The elements of this set fall into four categories, conveniently described by pairs of symbols  $(1,w)$ ,  $(1,b)$ ,  $(2,w)$ ,  $(2,b)$ , so that, for example,  $(2,w)$  stands for a pair of selections in which the second box was selected in the first instance, and then this was followed by the selection of the white ball. Denote by  $n_{1,w}$ ,  $n_{1,b}$ ,  $n_{2,w}$ , and  $n_{2,b}$  the (unknown) numbers of the elements of F.P.S.

belonging to each of the above categories, and by  $n$  their sum. Then the probability sought

$$P\{w|\text{pair of selections}\} = \frac{n_{1,w} + n_{2,w}}{n}.$$

The conditions of the problem imply

$$P\{1|\text{pair of selections}\} = \frac{n_{1,w} + n_{1,b}}{n} = \frac{1}{2}$$

$$P\{2|\text{pair of selections}\} = \frac{n_{2,w} + n_{2,b}}{n} = \frac{1}{2}$$

$$P\{w|\text{pair of selections beginning with box No. 1}\} = \frac{n_{1,w}}{n_{1,w} + n_{1,b}} = \frac{1}{2}$$

$$P\{w|\text{pair of selections beginning with box No. 2}\} = \frac{n_{2,w}}{n_{2,w} + n_{2,b}} = \frac{1}{2}$$

It follows

$$\begin{aligned} n_{1,w} &= \frac{1}{2}(n_{1,w} + n_{1,b}) = \frac{1}{4}n \\ n_{2,w} &= \frac{1}{2}(n_{2,w} + n_{2,b}) = \frac{1}{4}n \\ P\{w|\text{pair of selections}\} &= \frac{5}{12}. \end{aligned}$$

The calculation of probabilities by direct enumeration of all the objects  $A$  and of those that possess the property  $B$  is frequently cumbersome, and this justifies the use of the multiplication and the addition theorems. However, the ability of a student to solve any given problem by the direct method is a useful check of whether he understands what he is actually doing in applying the two fundamental theorems. Therefore, in all of my courses examples of the above type are offered to students with extensive discussions. Some fourteen years ago Miss Hosiasson was, for a short period, an assistant of mine. If she had suggested the above example otherwise than as a joke, then she must have forgotten what she had learned at that time.

3. Section 14, and the following, of the main text are largely given to the discussion of the two kinds of errors that one can commit while testing any statistical hypothesis. These errors then and their probabilities are the most fundamental concepts of the theory of testing statistical hypotheses. While a considerable number of statisticians have found these conceptions useful, some others disapprove of them and even regret the very existence of the theory of testing statistical hypotheses. The main proponent of this latter school of thought seems to be Professor R. A. Fisher. Two short quotations will sufficiently illustrate his point of view.

In his very interesting book, *The Design of Experiments* (Oliver and Boyd, Edinburgh, 1935, pp. ix + 252), p. 20, Dr. Fisher writes: "The 'error,' so-called, of accepting the null hypothesis 'when it is false,' is thus always ill-defined both in magnitude and frequency." In another instance (*Annals of Eugenics*, Vol. 11 (1941), p. 143), reviewing some results published around 1925 and earlier, he remarks: "No misunderstandings were apparent at this period; perhaps because writers without sufficient logical penetration had not at that time undertaken the elaborate theories of 'testing hypotheses' which have appeared in recent years."

One could easily collect a number of similar quotations illustrating Dr. Fisher's consistent disapproval of the theory of testing statistical hypotheses in general and of the concept of the errors of the second kind in particular. It is, therefore, with a considerable surprise that one finds in the paper just quoted

and on the same page, the following passage not only showing that Dr. Fisher appreciates the importance of probabilities of errors of second kind, but also suggesting that he has claims for some priorities in the matter.

"In 1931, in the introduction to the Hh function published by the British Association in the first volume of their *Mathematical Tables* (Fisher, 1931), I gave the solution of an allied problem closely akin to the more recent developments.

"If  $\alpha$  is the true deviation of a value in terms of the true standard deviation  $\sigma$ , and  $a$  is the apparent deviation in terms of the estimate  $s$ , then

$$\mu + \alpha\sigma = \bar{x} + as,$$

and for each value of  $\alpha$  the quantity  $a$  will have a determinate sampling distribution depending only on the sample number  $n$  and the deviation  $\alpha$ . The solution is of value in a number of practical problems, for, given  $\alpha$ , the percentile values of  $a$  are calculable, and given  $a$  the corresponding percentile values of  $\alpha$ . For an industrial product,  $\alpha$  may determine the percentage of the total output which fails in a specific test, and if  $a$  is designed to set the limits of a test included in a specification in such a way that the probability of failure to meet the specification is controlled, so as not to exceed some known value, the corresponding value of  $a$  shows how far the specification can go, even on the basis of a limited number of routine tests.

"The solution given in the British Association Tables (Fisher, 1931), and for which the fine table of the hyperbolic Hermite function Hh was specially calculated by Dr. J. R. Airey, was adopted without acknowledgement by a pupil of Dr. Neyman, a certain S. Kołodziejczyk, who published a note (Kołodziejczyk, 1933) in the *Comptes Rendus* of the Académie des Sciences. As I had previously rather pressed this solution on Neyman's notice, owing to its important industrial applications, I was led to inquire why no acknowledgement was given of the origin of the solution, but acknowledgements only to Neyman's writings. Dr. Neyman assured me, however, that in the original form of the note, reference to my introduction had been inserted, but had been cut out by the editor of *Comptes Rendus*, in shortening Kołodziejczyk's note. So far as I know, neither Neyman nor his follower has done anything to rectify the invidious position in which they have been placed."

The paper by Dr. Kołodziejczyk complained of above is mentioned in the main text as reference [35]. As described in the title, its contents are a table of probabilities of errors of the second kind when testing the hypothesis that the mean of a normal population has a specified value and a simple formula from which these probabilities were calculated. It would appear from the above quotation that Professor Fisher was also interested in errors of the second kind, has anticipated Dr. Kołodziejczyk in the, at least preliminary, solution of the problem and pressed the present writer for its completion.

While welcoming Dr. Fisher's change of mind on the importance of probabilities of errors of the second kind in such problems as he mentions, which are essentially problems of experimentation in general, I have to deny all his claims.

In the first place, I do not remember his pressing any problems on my attention and, before Dr. Kołodziejczyk's paper was published (1933), he had hardly had occasion to do so. Before the spring of 1934 I had met Dr. Fisher only on one or two short courtesy visits to Rothamsted, each lasting one or two hours, and spent in visiting laboratories, tea, and general talk.

Dr. Kołodziejczyk's paper is a natural development of what was published by Professor E. S. Pearson and myself, the idea of errors of the second kind appearing first in 1928 [8]. This latter idea being clear, to get Kołodziejczyk's results it was only necessary to decide to compute them and to carry out the computations, which he did. It happens that the same probabilities could have been obtained from the results of Fisher which he mentions. This, however, would require more labour than Kołodziejczyk expended in using his simple formula. The question still arises whether Professor Fisher was actually working on the same problem as Dr. Kołodziejczyk and was merely less successful. Apart from the remarkable skill of Professor Fisher, which makes this hypothesis unlikely, there is considerable documentary evidence against it. If the object of Dr. Fisher's contribution to the British Association Tables was actually to facilitate the calculation of probabilities of errors of the second kind, then, no doubt, he would have mentioned this circumstance in his article. Also, presumably, there would have been some reference to the papers in which the concepts of the two kinds of errors were first introduced. However, no such references are present in Dr. Fisher's article. Further, if the idea that the probabilities of errors of the second kind are important in problems of industrial experimentation (why only industrial?), was already clear to Dr. Fisher in 1931, how would it be possible for him not to mention it in 1935 when writing a book especially given to problems of experimentation? Actually, *The Design of Experiments* seems to include only one reference to errors of the second kind, namely, the one quoted above.

The answer to all these questions seems to be that when writing his contribution to the British Association Tables, Dr. Fisher must have had in mind not the problem of Dr. Kołodziejczyk but some other problems, and a glance at Kołodziejczyk's note shows that Fisher's results were not helpful to him in any way.

In these circumstances, dealing with a different problem and using a different method, a reference to Fisher's work would be courteous but not strictly necessary. After these nine years since the publication of Kołodziejczyk's note in the *C. R.* it is difficult for me to remember whether its original MS. did or did not contain such a reference. Neither do I remember the occasion on which, according to Fisher, I told him that such a reference was present but was cut off by the editor of *C. R.* This, however, may actually have happened. As is well known, the authors who were not members of the Paris Academy were limited to something like 2·25 pages per note. This rule was very strictly enforced, frequently without the authors being consulted. Such a cut was actually applied to Kołodziejczyk's paper, which contains but a part of his table. On the other hand, it is also possible that, in an effort to make his note as short as practicable, Kołodziejczyk decided to include only references that were strictly relevant.

However, Kołodziejczyk's tables appeared in full in a joint paper, published in the *Supplement to the Journal of the Royal Statistical Society*, Vol. II, 1935, and a footnote on page 131 states as follows :

“ A part of Table IV has been originally published by S. Kołodziejczyk in *Comptes Rendus*, t. 197, p. 814. R. A. Fisher gave the expression of  $dp/dt$  in terms of the integral of the normal integral. See British Association Mathematical Tables, Vol. 1, 1931.”

Professor Fisher certainly had the opportunity of seeing this footnote and did not find anything objectionable in it. In fact, the paper just mentioned was read before the Industrial and Agricultural Section of the Royal Statistical Society and Professor Fisher honoured it by a lengthy and interesting discussion. In so doing he registered a number of protests, duly recorded at the end of the paper, but the adequacy of the footnote was never questioned.

## A SHORT GUIDE TO PRE-WAR ENGLISH OUTDOOR VEGETABLE STATISTICS.

By W. F. DARKE, Ph.D.

ONE of the outstanding features of the economic depression of the last decade was the emergence of vegetable-growing as a major farming activity. At the outbreak of War, vegetables were no longer the traditional monopoly of the small-holder and the professional market-gardener because in certain parts of the country, particularly in East Anglia, vegetables had become an integral part of the cropping rotations and animal feeding policies of many a large mixed farm. After three years of war the Ministry of Food has re-affirmed the necessity of fresh vegetable supplies in a war-time diet very much depleted by the curtailment of imported fruit, and we can be sure that, if post-war planning places sufficient emphasis on the importance of adequate nutrition, there will be necessarily substantial developments in vegetable production after the War.

To guide the various post-war planning groups now in existence and to anticipate much future interest in this subject, it may be desirable to review the pre-war vegetable statistics with a view to guiding economists and others through a veritable thicket of statistical traps. There are not many published or collected figures, and what there are present more difficulties than are usually found with agricultural statistics—themselves very difficult and abstruse compared with basic data of other industries. This is due not so much to the faulty collection of data, as to the number of unusual features connected with vegetables which do not occur with other agricultural products. In this paper, discussion is restricted to crops grown in the open air. Production under glass, although growing in importance, is still relatively unimportant, and presents special statistical problems of its own.

Vegetables for human consumption have only recently assumed importance in English agriculture, and even in 1939 they amounted only to about one per cent. of the total area under crops and grass. Treating early potatoes as a farm crop (and ignoring tomatoes which are always treated as fruit for such purposes as customs duties and railway rates), this area is shared by approximately fifty different vegetables—without going into the numerous permutations of the different varieties within each species. Besides this diversity we have to remember that several of the larger acreages of vegetables, such as cabbages, carrots, peas and beans, have double identities. They may be gathered for human consumption, but they may also be used as fodder crops. It is true that the *Agricultural Statistics* \* divide the cabbage crop into "Cabbage for human consumption" and "Cabbage for fodder", but there is nothing binding about the farmer's classification when he fills in his Annual Returns on June 4th each year. When the cabbage crop is ripe he may find market prices so low that they do not cover the costs of picking, and then he may turn his sheep on produce originally destined for human consumption. On the other hand, if prices are high he markets some of the produce normally used for feed. Indeed, this growing realization of the dual capacity of vegetables is one of the chief reasons for the increased acreage in modern times and their growing popularity on all types of farms.

\* Compiled annually by the Ministry of Agriculture and published by H.M.S.O. London.

Another factor militating against the satisfactory continuity and reliability of published data is the relative mobility of nearly all kinds of vegetables. They are mobile in several ways. First of all, unlike fruit, vegetables have no fixed localities of production, for within fairly wide limits they can be grown anywhere and there is no relatively heavy concentration of fixed capital necessary. Not only are they grown in most farming districts, but they are switched round in the general farm rotation—often in an opportunist fashion. The acreage is thus harder to check than that of fruit orchards, which, once planted, are fixed for many years. Secondly, there is a wide flexibility in the season, for both planting and harvesting times have fairly wide limits when compared with other farm crops, particularly cereals. For example, inability to get the ground ready in time for an early spring planting of lettuce is not necessarily a serious blow to the ordinary non-specialist vegetable-grower, because it is a quick-maturing crop and the season lasts well into the autumn. If events should conspire against the successful planting of a certain crop in an intensive annual rotation, very often the succeeding crop can be brought forward without much trouble. Thirdly, the mobility of vegetables is demonstrated by their prominent use in catch and double cropping practised by many specialists. Thus cabbage may be used as a summer stop-gap between ploughing and the next autumn-sown cereal, while any of the cabbage family, brussels sprouts, or sprouting broccoli may be interplanted with potatoes or spinach, so that we have the problem of classifying an acre of land which may be supporting two or three acres of different crops at the same time. If ordinary cropping were adopted in this case, one acre of potatoes might be returned, and it might be unwise agriculturally to plant them close together. If cabbage is interplanted between the rows, another acre of crops is grown on the same land, and yet it is misleading to describe the land as  $\frac{1}{2}$  acre potatoes and  $\frac{1}{2}$  acre of cabbage. As this intercropping is usually an opportunist practice, not occurring necessarily at the same time each year, it is difficult to estimate and adds to the difficulty of measuring crop acreages accurately.

*Acreages.*—At this point it may be of interest to examine what vegetable statistical material is available and to point out some of the weaknesses of the available information in the case of individual vegetable crops. Agricultural returns were first collected on a national scale in 1866, and since the first schedule was of an experimental nature and secured on a voluntary basis, there were a number of gaps in the more vital figures, and it is not surprising, therefore, to find the vegetable statistics very scanty and mainly grouped together under the heading of "garden crops". The cabbage area chiefly related to the fodder crop, but may have included some of the table varieties. From the beginning various vegetable figures appeared intermittently and from 1906 there is a regular report on areas under carrots and onions, although, as the agricultural returns were not made compulsory until 1935, the entire acreage actually grown may not then have been reported. As the carrot acreage to this day includes some white and other varieties used for fodder purposes, the onion acreage is really the only vegetable going straight into channels of human consumption with a good statistical history. Other vegetables were tabulated in due course. Celery and rhubarb acreages appeared in 1912; brussels sprouts and cauliflowers in 1914, and it was not until 1922 that cabbage for human consumption appeared separately.

The Agricultural Returns for 1925 separated the acreages for beans picked



green and peas picked green from the total acreage for beans and for peas. These new classes were very necessary refinements, for a large part of these crops are always threshed dry for animal feeding or for the milling trade. Even so, these refined figures for peas and beans must not be taken as the real amount grown for human consumption in these years, because the areas include a proportion cut green for silage and fodder purposes.

From 1926 to 1935, therefore, there is a straight run of nine separate vegetable acreages. In 1935, acreages of asparagus and lettuce were identified for the first time, and peas and beans were still further defined, because three categories were established for the former,—viz. “Peas for Stock-feeding or Seed”, “Green for Market”, and “For Canning or Packeting Green or Dried”,—and two categories for the latter,—viz. “Beans for Stock Feeding or Seed”, and “Beans for Market and Canning.” Generally speaking, we might take “Peas for Canning or Green Peas” as corresponding to the former headings of “Peas picked Green”, and “Beans for Market or Canning” as corresponding to “Beans picked Green”, but nevertheless the continuity of the series, especially that of peas, suffered somewhat from this change in classification. Incidentally some readers may have noticed that the total pea and bean acreages mentioned in the first tables of the annual Agricultural Statistics do not always agree with the sub-divisions given in the later pages. This is due not to careless clerical work or printers’ errors but to the fact that not all the acreage planted actually matures and the more detailed tables give the areas actually harvested.

We may summarize the available (tabulated) acreage statistics as follows:—

Continuous since—					
1907	1912	1914	1922	1926	1935
Carrots. Onions.	Celery. Rhubarb.	Brussels Sprouts, Cauliflower or Broccoli.	Cabbage etc. for Human Consump- tion.	Peas picked Green. Beans picked Green.	Asparagus. Lettuce. Peas for Stock-feeding for Seed. Green Peas for Market. Peas for Packeting, Green or Dried. Beans for Stock-feeding or Seed. Beans for Marketing or Can- ning.

Although these acreages are a continuous series, their usefulness is limited. They represent the crops actually in the ground on June 4th each year. While this is a date admirably suited to a census of farm stock, unfortunately it is not the optimum date for measuring certain vegetable crops. For example, on June 4th a farmer may only be reporting a fraction of his year’s acreage of carrots, because the bulk may be planted after this date and yet harvested before the next Census. For the same reason it is possible for only a proportion of individual crops such as cabbages, brussels sprouts, beans, cauliflowers, spring greens and celery to be recorded on June 4th. Owing to climatic conditions affecting the times of planting, these proportions are by no means the same each year, and they cannot be ascertained without an inordinate amount of trouble. It seems, therefore, that all these practical snags connected with the annual figures of acreages on June 4th make the figures unsuitable for use in any advanced statistical analysis and for the basis of any detailed argument.

There are additional reasons why one must not try to do too much with these figures. These acreages do not represent total production. All vegetables grown on less than  $\frac{1}{4}$  acre—and there must be hundreds of small parcels of mixed

crops on farms and small holdings throughout the country—are grouped together in the annual returns, and individual vegetables in this aggregate are not distinguishable with any accuracy.

We also have to remember that these acreages do not necessarily represent the same product, even though they may come under the heading of carrots, onions, cabbage, peas and beans, etc., etc. When it comes to measuring physical outputs and their monetary values this point becomes plain. Carrots and onions may be either picked young and sold in bunches for salads or left longer for a main crop. Peas can either be picked green for the market or for canning, or they can be dried for packaging or kibbled for cow and animal feed. From a theoretical point of view, they are different goods with separate prices and uses.

Yet another trap to the unwary in dealing with these acreage figures is connected with the rhubarb figures. The annual acreage figure includes first crowns which do not bear until the following year. In any given year the proportions of these crowns may vary, and it is therefore impossible to tell the acreage of bearing rhubarb from the available figures.

*Yields.*—When it is stated that the acreage data are the best of the statistical material concerning vegetables, it will be realized that the information concerning yields is almost negligible. In fact, the only regular annual official figures concern onions and carrots. This paucity of information is once again connected with many technical difficulties not encountered with other crops. The time of the cereal harvest is fairly well defined, and the crop is physically capable of easy measurement, and it is this comparative neatness which emphasizes the nature of the vegetable industry and the difficulties of measuring its miscellaneous output.

The actual time of cutting cabbages depends on their time of sowing, and we have seen that this is most flexible. The actual time of harvesting in turn affects the bulk yield. It is possible for the yield of summer cabbage to be far different from that of autumn or winter varieties. The weight of small bunched carrots per acre is much smaller than that obtained from those left to mature some months later. Another matter concerns the definition of what is meant by yield. Does it mean the cabbage with all its outside leaves, or should it mean the products dressed ready for the consumer? Should it be washed or “field run” carrots? This practice varies from farm to farm, and there appears to be no accepted standard method of calculating yields at all.

Another hindrance to a measurement of an actual market output calculation is that any yield quoted for vegetables and applied to the total acreage by no means represents the amount of produce moving into the market. On most farms very rarely is the entire crop sold. Most vegetables have to be harvested within a short time of maturity. Asparagus and cauliflowers, for example, have to be removed within two days of reaching a marketable state in the field. In hot weather peas become hard very quickly, and some varieties, such as “Senator”, deteriorate after one day; in the case of Cos lettuce, seed stems may appear three days after maturity. On larger mixed farms, therefore, it is doubtful whether there is always a sufficiently large labour force available for picking immediately the crop becomes ripe, and then only a portion of the crop may be removed in marketable condition. Moreover, under some price levels it only pays to harvest a proportion of the crop, and either to feed the remainder to animals or to plough it in for manure. It follows, therefore, that (for certain types of analysis) it is insufficient to multiply the acreage by the

yield to obtain the market output, because only a varying annual proportion of the crops actually leaves the field. In addition, as we have seen in some seasons, a portion of animal fodder crops, such as kale and cabbage, may be sent to market if the price is sufficiently attractive and supplies of normal market garden produce are short.

With these warnings, we may examine the available information on yields. The only official annual figures pertain to onions and carrots, and even these may be misleading, for the onion yield refers to ripe bulb onions only, whereas the carrot yield represents the average of both bunched and main-crop carrots. The data for other crops are sparse. In 1925, the *Agricultural Output Report*\* outlined the yields per acre of the main vegetable crops enumerated in the agricultural statistics. These were estimated by the Crop Reporters. This same procedure was followed again in the *Agricultural Output 1930-1*,† and in the light of further experience the yields of cabbage and cauliflower in 1925 were thought to be too high and those for peas and beans too low, and were consequently adjusted. It is worth noting here that special census forms were sent to farmers who returned 40 per cent. of the main vegetable crops in 1925 and 55 per cent. in 1931, and yet it was still impossible to obtain any satisfactory account of the minor vegetables crops.

For statistical workers who are needing further information concerning yields, the following estimates may be useful. They are based on miscellaneous data, and represent the physical yield which might be reasonably expected to move from the field into commercial channels under normal conditions. It must be emphasized, however, that there is a large variation between area and area, farm and farm, and between one year and another, and that local deviations from the mean are to be expected.

	Tons per acre		Tons per acre		Tons per acre
Asparagus ...	1	Celery ...	8	Parsnips ...	14
Beans—Broad ...	3	Kale ...	9	Peas—Green ...	2
—French ...	2	Leeks ...	8	—Canning ...	2
—Runner ...	4	Lettuce ...	6	—Dry ...	0.6
Beet ...	12	Marrows ...	20	Rhubarb ...	12
Broccoli ...	9	Mushrooms ...	13	Spinach ...	3
Brussels Sprouts ...	4	Onions (Salad) ...	10	Turnips ...	11
Cabbage ...	10	Onions ...	6	Swedes ...	11
Carrots ...	11				

In order to make these estimates more accurate for any particular year, they can be adjusted by means of the following scale used by the Horticultural Inspectors of the Ministry of Agriculture who report on crop conditions in their particular province from time to time:—

100-81 ...	very good.
80-61 ...	good.
60-41 ...	fair.
40-21 ...	bad.
20-0 ...	very bad.

These reports are usually published in the *Agricultural Market Report*, at the end of each month except December, and might very well be more utilized than they are at present.

\* Cmd. 2815, pp. 31 *et seq.*

† Cmd. 4605.

**Prices.**—Having dealt with acreages and yields, we come to prices. As in the preceding paragraphs, there are immediate difficulties, which are as exasperating as those others already mentioned, but which are perhaps a little more known and appreciated by those accustomed to working with market statistics.

Owing to the highly perishable nature of most vegetables, it follows that quality at the time of sale is all important. But this is the most difficult of all things to put on a common basis and to measure accurately. The National Mark standards for grading and packing went some way to achieve these objects, but at the outbreak of war, when this voluntary scheme had been terminated, only some seven types of vegetables \* were included in this scheme, and even these touched only a small percentage of the total annual production. With no recognized standards of quality the information concerning prices is therefore chaotic. The grading of No. 1 wheat is the same in any two Canadian markets, and their prices are comparable the world over, but nobody would claim that the price of brussels sprouts in Liverpool had any relation with the price of brussels sprouts in Plymouth on the same day. The matter is further complicated by the bewildering array of units used to measure vegetable sales in various localities. Such terms as a bundle of rhubarb, a pot, sieve or flat of peas, a score of lettuce, a tally of cabbages, a bunch of carrots, a crate of broccoli, a punnet of cress, a half bag of sprouts and so on have no recognized uniformity of weight in all markets. A bag of beans in Leeds weighs 40 lb. on the average, but only 36 lb. in London; a net of sprouts generally weighs 20 lb., but in Newcastle-upon-Tyne it is 2 lb. lighter. A crate of lettuce usually contains 24–36 head, while a score of them is reckoned as 22!

Another confusing feature of price recording is that a large proportion of vegetables is retailed direct to the public by small growers, and there are no means of relating these sales to the vicissitudes which occur in the officially recorded prices. There are, of course, a number of quotations for various markets noted in the newspapers and trade journals, but none gives the quantities actually passing from hand to hand. The wide variations in prices and the actual seasons well illustrate the difficulties of constructing an official index for the country as a whole. Nevertheless, there is a good deal of official information. The *Agricultural Market Report* gives an average weekly price for a fairly wide range of vegetables in season for first quality produce at certain carefully chosen representative wholesale markets.†

Most research workers, however, will want to use the Ministry of Agriculture Index of Agricultural Prices. There are two series of these. The first vegetable price series were started in 1913, and were based on the second quality prices of brussels sprouts, cabbage, cauliflower, carrots, celery and onions. These prices were also a straight average of all the market quotations, excluding any exceptional prices such as those which occur at the beginning and end of the season. The indices were annual, and not monthly, but they had the advantage of a clear run from 1906 to 1938, because the numbers were worked out in retrospect as far back as the former year.

In 1938 the second series was introduced, with three important changes

\* Asparagus, broccoli and cauliflower, bunched carrots, brussels sprouts, celery and cabbage lettuce.

† Since 1931 there have been eight representative markets—Birmingham, Bristol, Evesham, Leeds, Liverpool, London, Manchester and Newcastle. Prior to 1931, Newcastle was replaced by Hull.

occurring in the vegetables section. Peas and beans were added to the list, and an average of first and second qualities was taken with 1927–29 as the new base. Thus, the latest set of vegetable index-numbers ranges annually from 1927 and pertains to the eight common vegetables.

Although these prices are obtained from representative markets, where it is thought that the bulk of farmer-to-first-salesman takes place, there may be still some doubt as to whether they really represent farm prices, owing to the varied and complicated structure of our marketing system and the multiplicity of hands through which the produce passes. Indeed, the prices are known to include some element of marketing and transport costs, but in spite of these blemishes they are the best available and fairly reliable.

In view of the difficulties in calculating wholesale prices, it can be seen that any index purporting to be an average retail price must be very shaky indeed, considering the wide dispersion which grows as the product passes from hand to hand to the different types of consumer.

*Output Figures.*—As a result of the foregoing discussion it may be gathered that any figures showing the physical output and its monetary worth must be extremely tentative. For convenience sake, and because they are the most authentic figures, it is customary to quote the official output figures for this kind of information. In 1908,\* the first output inquiry was conducted, but the published data referred to Great Britain only. Evidence on yields and crop values was obtained from 28 per cent. of all growers who returned not less than two acres under the particular crops. The total estimated vegetable production was valued, and there were also a few detailed estimates of such crops as seakale, parsnips and beetroot. They are not too reliable.

In the *Agricultural Output* of 1925 † and 1930–31, ‡ special attention was given to some of the outstanding statistical problems confronting vegetable enumerators, and by means of special questionnaires some of the ordinary defects in the annual statements were remedied. By no means all of the errors could be rectified, however, and even these figures cannot always be used without reservations. Details were only given for the main vegetable crops, and the lesser types were once more estimated as a group, and this means that probably the only officially published estimate of the output and value of the different vegetable crops is the Appendix 1 to *Vegetable Marketing in England and Wales*.§ The information given here is mainly based on the 1930–1 Census, and relates only to 1930–1932.

The only other figures of note which are in common use are the estimated values of the vegetable output published every year since 1930–1 in connection with the annual estimated agricultural output of England and Wales.|| For these calculations an unusual technique is adopted. There is no attempt to measure physical output each year, but a comparable figure is built up from the last Census return. In order to see the limitations of this method in arriving at the value of output, it may be best to outline the method of calculation, which is :—

$$\frac{\text{Value of Vegetables 1930-1} \times \text{Total acreage of all Vegetables in Year} \times \text{Vegetable Price Index in Year}}{\text{Total acreage of all vegetables in 1930-1} \times \text{Vegetable Price Index in 1930-1}}$$

\* Cd. 6277.

† Cmd. 2815.

‡ Cmd. 4605.

§ Ministry of Agriculture Economic Series, No. 25 (pp. 172–3).

|| Ministry of Agriculture Annual Agricultural Statistics, Part 1.

In other words, the annual output is not measured anew each year as in the case of the major farm products. Owing to the enormous amount of detail involved and the considerable margin of error in each item, the annual figure is based on the last output information, which was that of 1930-1. The flaws in this method are obvious, for the composition of both vegetable acreages and their weights in the price index changes from year to year. The approximate nature of this calculation should, therefore, always be borne in mind by those who are apt to take these figures without question. Any amendment of this method would require a mass of information and estimation, both for acreage, yields, proportions of crop actually sold off the farm, and again for the price actually received by the grower.

We have seen that the intrinsic difficulties facing a proper compilation of vegetable statistics would make the collection of this material a costly and lengthy task. This country is no California, with hundreds of acres of whole districts under the one crop and with specialized trade and rail facilities to market the produce in far-off cities. With our present farming pattern of scattered small and large growers varying their annual cropping acreages, and with ample opportunities of either selling retail locally or by other means, we cannot expect to have the accurate statistics of the U.S.D.A. or the elaborate price analysis studies of the Giannini Foundation. At present, we must be content with realizing the defects and the underlying difficulties of our own figures, so that they are not used in haphazard fashion by the uninformed if well-intentioned planners of the future.

In official circles the difficult nature of vegetable statistics is now well understood. War conditions have directed attention to vegetable supplies, and some progress has been made in overcoming the difficulties of enumeration. Crop returns are now being obtained at other dates than June 4th, and the Cropping Orders of the County War Agricultural Committees also enable a more accurate measurement of the acreages grown. The Fruit and Vegetable Section of the Ministry of Food has also built up an organization which has done much to fill in gaps of our knowledge in market supplies and prices. Nothing new on this subject may be published in war-time, but in the post-war period there is every likelihood of some good sound statistics of vegetables grown in the open, although production under glass may continue to remain a mystery for some time to come.

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## THE BEVERIDGE REPORT \*

By SIR GWILYM GIBBON, C.B., D.Sc.

THE acclaim with which this report has been received testifies to its quality and importance. It is a very different report from that which would probably have been produced if the subject had been remitted in the customary way to a commission or committee. The proposals, however, need to be coolly examined, in the interests of the very persons for whom they are primarily made.

This note must be brief and there is room only for a broad indication of the proposals and for a few comments. The principal proposals are these: Compulsory insurance to be extended to all classes, without limit of income. New benefits to be added to cover disability from industrial accident or disease (to replace present provision under the Workmen's Compensation Acts) and for funeral expenses (now widely provided through "industrial insurance"), in addition to the present classes. Benefits to be greatly increased—in money so as to be sufficient for minimum subsistence; in time so as to cover the whole period of need, but subject to specified conditions, such as an obligation to undergo training if unemployment prolonged: an additional maternity benefit is also included. A comprehensive health and rehabilitation service to be provided. Old age pensions to be paid only if the recipient has ceased to be gainfully employed; an increase of pension to be granted for each year of employment after the qualifying age (65 years for men, 60 for women).

The cost of insurance would be met, as now, by contributions from the insured, from employers (for those employed by them) and from the State, but at increased rates. The author rightly stresses the significance of retaining the tripartite scheme of contributions. In addition, an allowance (of 8s. a week) would be paid from public funds for each second and subsequent child up to the age of 16 years, if the child is still at school. The cost of the health and rehabilitation service would also be met from public funds, except for a substantial contribution from the insurance fund. A special levy is proposed on industries with exceptional risks of accident or industrial disease, over and above the normal insurance contributions.

The report proposes that the administration of the scheme shall be entrusted to a new central department, with a Minister of Social Security at its head, except for the service of health and rehabilitation. This is to be under the general charge of the central departments of health. The Social Security Department would take over from central and local bodies the services of public assistance, except the institutional, and also the training, and possibly the employment, services from the Ministry of Labour. There would be one comprehensive scheme of social insurance instead of the present separate schemes with their anomalous differences.

The present system of Approved Societies for sickness insurance would be abolished and benefits be administered by the central department and its local offices, with a reservation for Friendly Societies and Trade Unions, bodies with genuine self-government. The administration of benefits would be delegated to any of these which provided benefits similar but additional to those of the

\* *Social Insurance and Allied Services*, Report by Sir William Beveridge. Cmd. 6404. 299 pp. Stationery Office. 2s. net.

State scheme. It is proposed that the central department should undertake voluntary "industrial" (as distinct from ordinary) insurance over and above that in the compulsory scheme, on the ground that this might otherwise not be provided at all, under the new conditions.

The estimated finances of the scheme are broadly as follows:

Cost of proposed scheme in 1945—£697 millions (including cost of the health and rehabilitation service and of children's allowances); in 1965—£858 millions. The cost of the present insurance schemes is put at £432 millions for 1945. Of the increase of £267 millions between the two figures for 1945, £86 million would be met from national funds.

The estimated increase in the cost of the proposed scheme in 1965 over that for 1945 is £161 millions. The whole of it arises from old-age pensions. The proposed full rate of pension would be much higher than the present, but this full rate would be reached in stages spread over twenty years, during which the rate of pension would rise (for persons with complete qualification for contributory pensions) from 14s. a week for a single pensioner and 25s. for man and wife to 24s. and 40s. respectively; there will also be more pensioners.

The full cost of the health and rehabilitation service is estimated at £170 millions a year (at best a rough guess). £60 millions of this would be for kinds of services now rendered at the public expense and £40 millions would be met out of the social insurance fund, leaving a balance of £70 millions to be met from public funds.

So much for the general outline. Some body is given to the outline by the broad comparison (it is not intended to be more than that) of pre-war and proposed benefits at the close of this article, which is based on a table in the report.

The following are some brief comments, again no more than an outline. It is little wonder that a scheme so bold and embracing, so well and persuasively argued, has swept many off their feet. There are many big issues, however, which require consideration before final decision.

Two of them in particular have been stressed by the author himself:

(1) The proposals assume that mass unemployment will be prevented in the future, and that the average unemployment among the insured population will not exceed about 8½ per cent. (being equivalent to about 10 per cent. among the classes insured before the war, a figure which is much below the average in pre-war years). The prevention of mass unemployment is the crucial problem, and it would have been well if it had been considered before social security, but the choice did not lie with the author of the report. It is a problem which somehow must be beaten; just how is by no means yet clear. The task will not be easy, even though there is no reason for despair, and it is almost certain that it will not be beaten without spending a good deal of public money.

(2) There must be much more occupational mobility of labour, not only in place of employment but also in kind. "Social security" cannot afford stagnant pools of labour. Industrial changes have been many in recent years; they are likely to be still more in the coming years. Here again is a problem much more difficult and complex than generally realized. Provision of training by the Government will help, but will not carry us far towards a solution.



The following other issues may be mentioned:

(3) Social security is only one of many babies in the nursery, all clamouring for public favour and public money, as though war produced abundance and not hardship, perhaps salutary hardship, but none the less hardship—housing, education, public health services, agriculture and the rest. The public purse is not bottomless nor the digestion of the community unlimited for reforms within a short period, especially a period beset with the task of the change from the economy of war to that of peace, a task the more arduous because of big economic changes following on the war. Common sense counsels that priorities be settled before the country is committed to any of them. These comments remain true even though there is sound reason to expect a large increase in national wealth if we bend our wits to the post-war problems with enterprise and a sense of realities.

(4) Common sense counsels also that we be reasonably sure that accepted reforms will not materially impede that post-war prosperity on which all depends, including that of the export trade. Mere assurance that this and that can be done is not enough.

(5) It is little likely that a scheme on the proposed lines would be successful without much stricter discipline than during the inter-war years. There were then many failings, with Parliament among the offenders. Can this discipline be assured? Experience suggests that concentration of authority in a Government Department may be as much of a danger as a safeguard. The discipline of a good Trade Union or Friendly Society with a material financial stake of its own might well be sounder. The best discipline of all is that which comes from the man himself, and that is one reason (there are others) for considering further whether part of the necessary provision might not be left to the initiative of the insured themselves, despite the much that can be said to the contrary. The making of men is particularly important for democracy and in the building of character no adequate substitute of general application has yet been found for the discipline of having to provide for the ordinary needs of life.

(6) As the author of the report well knows, none better, there are unemployment-prone as well as accident-prone. Any comprehensive scheme is an indirect subsidy to this class, especially if there be no limit to the period of benefit. Is this prudent national policy, or even kindly in the long run? The answer depends partly on administrative discipline—but it goes deeper than this. A similar issue arises on sickness benefit, though perhaps not so acutely.

(7) The scheme would almost surely cost more than the estimate, as is almost always the case. For instance, a comprehensive health and rehabilitation scheme is scarcely likely to be obtained within £170 millions a year. Even before the war, the cost of municipal hospitals was rising rapidly, and they are still at a relatively early stage and are but one of the many services covered. Experience shows emphatically that it is not prudent to bank on any large savings. The high level of benefits would render them even less likely, indeed, the contrary.

Difficulties would probably arise about the application of some of the proposals of the scheme, such as that for a comprehensive medical service, to mention just one of some thorny subjects; but if it be generally agreed that the proposals are definitely desirable these difficulties should not frighten anyone off the road.

One more big issue of general policy may be mentioned because it has an important bearing on administration. There are great advantages in concen-

trating administration in a government department, but there are also drawbacks and dangers. There is urgent need of broadening and strengthening the practice of self-government throughout the country, in private and semi-public affairs as well as in public. There is still much that is crudely immature in our democracy. Trade Unions and Friendly Societies have been prominent among self-governing bodies, and their contribution to the broader democracy of recent decades has been great. It is well worth considering whether, despite the difficulties, they cannot be much more used for the administration of "social security," whatever form it may take, especially as there might be definite gain in discipline. And the case for doing so is not reduced by the fact that before the war about half the persons in sickness insurance were in societies without genuine self-government, and that the measure of actual self-government in the others can easily be exaggerated. If the daily affairs of John Citizen are to be managed more and more by government departments, even in detail, vigorous democracy is scarcely likely to flourish for long—the genuine article, that is, not just the appearance. Some may think that this comment wanders far from the subject, but it is of the very core even of social security, for this depends at least as much on morale as on machinery, especially in a democratic community.

Great as is the value of the report there is much that needs to be further considered, not to sidetrack but to fulfil "social security." Progress there must be, and there are likely to be even bigger developments during the next forty years than during the last, and they have been great.

We shall probably proceed by stages, as is our practice, and not a bad practice, because every big reform is an experiment. Monetary benefits raised, present anomalies removed, health benefits much enlarged—these are practically certain. So also probably are children's allowances, beginning with the second or third child; there is much to be said for the latter, with higher rates, because the portent of the increasing proportion of elderly persons in the population is ominous. It would be unwise to embark on sweeping changes until means of preventing mass unemployment and of securing much more occupational fluidity of labour have been more thoroughly explored. And, while striving to reduce the uncertainties of life, we should never forget that what the country needs above all are men and women strong in spirit as well as in body, well endowed with initiative and independence and courage, for it is upon such that the prosperity and well-being of the country will chiefly depend, especially in the testing years after the war.\*

#### CONTRIBUTIONS AND BENEFITS

(Particulars in ( ) and italics are of contributions and benefits under pre-war schemes. Sums stated in shillings and pence are weekly payments, those in pounds are lump-sums. An increase of 25 per cent. is assumed in post-war prices over pre-war.)

*Contributions.*—7s. 6d. for an employed man aged 21 years or more—4s. 3d. by the insured, 3s. 3d. by the employer (*1s. 7d. and 1s. 7d.*). Lower contributions for women and other classes. State contributions in addition.

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\* These comments were written before the discussions in Parliament (February 1943). Events after the last war and the outbreak of this present have painfully demonstrated the penalties of too ready credulity. Our democracy does not seem even yet to have taken the lesson to heart. The master-problem of "social security" is the prevention of mass-unemployment: surely it were wise to make this the first objective.

*Benefits* (for man with wife and two dependent children):

*Unemployment*.—56s., without time limit, but subject to training if unemployment prolonged (33s. for 26 weeks). *Disability* (not industrial)—56s., no time limit (15s. for 26 weeks, then 7s. 6d. without time limit, with addition in some cases). *Old Age*—40s. ultimately (see text), more if retirement deferred beyond minimum age (20s.). *Widowhood*—36s., with 8s. for each dependent child, for 13 weeks; afterwards, (1) so long as she remains a widow and has a dependent child, 24s. (less if earning), with 8s. for each such child, (2) widow without dependent child entitled to training benefit (18s. during widowhood).

*Maternity*—£4, with 36s. for 13 weeks if wife gainfully employed (£2, with another £2 if gainfully employed). *Funeral*—£20, smaller sums for children (nil). *Industrial Disability*—56s. for 13 weeks, then  $\frac{3}{4}$  of earnings with 56s. minimum and 76s. maximum ( $\frac{1}{2}$  earnings with 30s. maximum: option to accept lump sum). *Medical Treatment*—comprehensive, including hospital, dental, ophthalmic, nursing and convalescent home, for all members of family, also rehabilitation (general medical practitioner service, for insured person only, with additions in some cases).

[Some weekly rates of benefit have been increased in the course of the war-years—unemployment benefit by 5s., disability by 3s.; the pre-war maximum of 30s. for industrial disability has been raised to 35s., with a further 4s. for each of the first two children and 3s. for each other. The pensionable age for women has been lowered from 65 years to 60. Contributions have also been increased—for an adult man from 1s. 7d. to 1s. 10d., payable by the insured and his employer.]

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## REPORT OF THE COUNCIL

*For the FINANCIAL YEAR ended December 31st, 1941, and for the SESSIONAL YEAR ending June 16th, 1942, presented at the ONE HUNDRED AND EIGHTH ANNUAL GENERAL MEETING of the ROYAL STATISTICAL SOCIETY, held at the London School of Hygiene and Tropical Medicine, W.C.1, on June 16th, 1942.*

THE Council have the honour to submit their One Hundred and Eighth Annual Report.

The roll of Fellows on December 31st, 1941, as compared with the average of the previous ten years, was as follows:—

Particulars	1941	Average of the previous ten years
Number of Fellows at end of previous year ... ..	1079	1057
Number lost by death, withdrawal, or default ... ..	65	58
Fellows elected or restored to the list ... ..	60	60
Number of Fellows on December 31st ... ..	1074	1059

In addition, there were 11 Honorary Fellows.

The Council regret to report that during the sessional year ended on June 16th, 1942, the Society lost by death the undermentioned Fellows:—

	Date of Election.
Beaven, Edwin S. ... ..	1905
<i>cdp</i> *Birkett, Matthew S., O.B.E. ... ..	1917
Bryant, Margaret Anne ... ..	1933
Crosse, The Ven. E. Francis, J.P. ... ..	1934
Keen, William B. ... ..	1885
Oakley, Col. H. J. P., M.C., F.I.A. ... ..	1939
<i>cdp</i> *Spensley, James Calvert, O.B.E. ... ..	1897
Springer, Leopold ... ..	1919
Stoll, Sir Oswald ... ..	1922
White, Richard, F.C.I.S. ... ..	1905

\* Life Fellow.

† Guy Medallist.

*c* Served on Council.

*d* Donor to the Library.

*p* Contributed to Proceedings.

The Council especially deplore the loss of two valued colleagues, Mr. M. S. Birkett and Mr. Calvert Spensley. Both had served long terms on the Council, had read papers at Meetings, made gifts to the Library, and rendered generous assistance to the Society in many ways. Mr. Spensley, especially, after his retirement from the service of the London County Council, was a very active member of the Executive Committee, and interested himself particularly in the Library. Obituary notices of Mr. Birkett and Mr. Spensley appeared in the *Journal*, in Part III, 1941, and Part I, 1942, respectively.

During the session 1941–42, the following 56 candidates have been elected Fellows of the Society:—

Baker, Cecil John.  
 Bilbrough, Norman Heslop (restored).  
 Carpenter, Percy Frederick, F.C.A.  
 Coote, Lily Agnes.  
 Crookes, Herbert Edmund.  
 Dowker, Edwin Henry.  
 Forrester, Reginald Grant.  
 Golding, Percy Thomas Frank.  
 Grumbridge, Jack Louis.  
 Hamdi, Mohamed Mazloun, B.Sc.  
 Hanson, Edward Stanley, F.L.A.A.  
 Hanson, Harold Buckley.  
 Hassanein, Mahmoud Mostafa.  
 Hymans, John Clifford Stanley (Capt.),  
 Jeejeebhoy, Phiroze Jamshedji.  
 Kirk, John Henry.  
 Knapp, John Andrew.  
 Kohnstamm, Alfred.  
 Leslie, John Baptist.  
 Martin, Cyril John.  
 Martin, William John.  
 Maung, Khint.

Monk, John Norman.  
 Moss, Louis.  
 Moyal, Jose Enriques.  
 Orensteen, Sam M.  
 Peel, the Hon. George.  
 Penny, Augustine St. Clair.  
 Richmond, F. E.  
 Robinson, Isaac Vincent, M.Inst.C.E.  
 Samuel, H.  
 Schwartz, Eli.  
 Seet, H. H.  
 Seldon, Arthur.  
 Snook, Trevor William, A.C.I.S.  
 Thomas, Alfred Ronald Evans.  
 Walker, Sydney.  
 Wayman, Lt.-Col. Myers, O.B.E., J.P.  
 White, Gilbert Vincent.  
 Williams, Frank Herbert Binham.  
 Wilson, J. G.  
 Womersley, John Ronald, B.Sc.  
 Wood, William Arnold (Staff Captain).

#### Corporate Representatives.

Bičanič, Dr. Rudolf,	<i>representing</i> the Yugoslav Ministry of Finance.
Brugel, Dr. John,	<i>representing</i> the Czechoslovak Ministry of Economic Reconstruction.
Burchardt, F. A.,	<i>representing</i> the Oxford Institute of Statistics.
Dawson, Thomas Rayner,	<i>representing</i> the Research Association of British Rubber Manufacturers.
Fairchild, Edwin C.,	<i>representing</i> the Co-operative Permanent Building Society.
Gutfreund, Emil,	<i>representing</i> the Czechoslovak Research Institute.
Harrington, Eustace Woods,	<i>representing</i> the Northern Assurance Company, Limited.
Hill, Philip Maurice,	<i>representing</i> the Chamber of Shipping of the United Kingdom.
Kellett, W. G. G., M.Sc.	<i>representing</i> the International Rubber Regulation Committee.
Liddell, Helen Grace,	<i>representing</i> the Royal Institute of International Affairs.
Moss, Louis,	<i>representing</i> the War Time Social Survey.
Rissik, Hendrik,	<i>representing</i> Standard Telephones and Cables, Limited.
Stone, Feodora,	<i>representing</i> the National Institute of Economic and Social Research.
Wise, Mervyn Edward,	<i>representing</i> the Mullard Radio Valve Factory.
Wynants, Maxime,	<i>representing</i> the Belgian Commission for the Study of Post War Problems.

The number of Fellows is now 1050,\* compared with 1053, in June 1941.

Ordinary Meetings, which were again suspended during the winter, were held in March, April, May, and June, 1942, while, as in the two preceding

\* Revised figure.

years, other papers which had been accepted for reading were published in the *Journal* with comment contributed in writing. The full list of papers is as follows:—

GREENWOOD, Professor M. British Loss of Life in the Wars of 1794–1815 and in 1914–1918.

Discussion on Post-War Reconstruction, opened by Mr. R. G. GLENDAY.

(March 17th, 1942.)

KENDALL, M. G. The Future of Statistics.

(April 21st, 1942.)

SCHWARTZ, G. L. The Significance of Fiscal Statistics.

(May 19th, 1942.)

MASSEY, P. H. Expenditure of 1360 British Middle-class Households in 1938–39.

(June 16th, 1942.)

STOCKS, PERCY. Measles and Whooping-Cough Incidence before and after the Dispersal of 1939–1941.

The procedure adopted in the previous session with respect to candidates for election was continued; that is, approval by the Executive Committee was held to confer the main privileges of Fellowship pending formal election at a meeting. The 41 candidates so approved during the period July 1941 to March 1942, were duly elected at the March meeting.

In order to comply with the official restrictions on the consumption of paper, certain changes have been made in the *Journal*. In the 1942 volume the print has been slightly reduced in size without, it is thought, any loss of clarity, and the page-area of the text slightly increased; some of the preliminary lists and notices are being omitted, and space is being saved in every other practicable way.

The Industrial and Agricultural Research Section have now reluctantly decided that their activities must be suspended until the end of the war. Most members of the Committee and many other members of the Section are engaged on research work for the Government and have no time to spare for the preparation of papers. The second part of Volume VII of the Supplement, published in April 1942, will thus be the last issue until further notice. The necessity is the more regretted since the work of the Section was becoming increasingly known and appreciated abroad; that work will be resumed as soon as conditions permit.

In the year ended May 31st, 1942, 559 works were added to the Library, compared with 618 the year before. These figures exclude periodicals regularly received and a number of Parliamentary Papers. During the same period 1578 volumes were borrowed by 634 Fellows, against 1,298 by 510 Fellows the year before. The Society's Library has again been extensively used by our Government Departments and by representatives of Allied Governments in London.

The Council have judged it expedient to remove many of the older volumes in the Library to places of greater safety. These works, none of which is of later date than 1910, could not, generally speaking, be replaced if they were destroyed, and since their value is mainly historical they are in comparatively little demand for consultation in the present circumstances.

The abstract of the Treasurer's Accounts, viz., a Statement of Income and Expenditure for the year 1941 and the Balance Sheet as at December 31st, 1941, together with the report of the Auditors thereon, are given in Appendices A and B respectively.

## APPEN

## STATEMENT OF INCOME AND EXPENDITURE

## EXPENDITURE.

1940						1941						
£	s.	d.	£	s.	d.	£	s.	d.				
			380	0	0	Rent ... ..		380	0	0		
			142	13	4	House Expenses ... ..		212	9	10		
						Salaries and Wages (including contribution to Staff Super- annuation Scheme) ...		808	10	6		
			783	5	2	Pension and Allowance ...		189	0	0		
			189	0	0	Meetings:—						
43	17	2				Ordinary and General ...	35	12	9			
2	0	5				Research Section ... ..	—	—	—			
			45	17	7					35	12	9
						Publication and Distribution Expenses:—						
815	9	3				Journal and Reprints ...	496	1	6			
6	6	10				Supplement ... ..	94	15	5			
			821	16	1					590	16	11
						Library:—						
41	15	2				Books ... ..	13	17	8			
88	2	3				Binding ... ..	17	15	6			
			129	17	5					31	13	2
			20	9	4	Furniture and Office Equipment				—	—	—
			20	16	1	Insurance ... ..				21	1	2
						Stationery and Miscellaneous						
			64	7	7	Printing ... ..				31	3	2
			58	10	0	Postage and Telephone ...				46	15	2
			3	0	0	Guy Medal ... ..				—	—	—
			23	13	4	Miscellaneous Items ... ..				12	14	5
			36	15	0	Auditor's Fee [1940] ... ..				36	15	0
			—	—	—	War Damage Insurance ...				238	14	1
			2,720	0	11							
						Balance carried to Accumulated Fund: Excess of Income over Expenditure for the year 1940 ... ..						
			116	11	8							
			2,836	12	7					2,635	6	2
						Amount carried to Life Compo- sition Fund ... ..				52	10	0
			21	0	0							
			£2,857	12	7					£2,687	16	2

## DIX A.

FOR THE YEAR ENDED 31st DECEMBER, 1941

INCOME.									
1940					1941				
£	s.	d.			£	s.	d.		
1,598	2	0	Annual Subscriptions	...	1,488	18	0		
695	4	3	Sales of Journal and Reprints	...	448	1	7		
15	6	0	Journal Advertisements	...	3	10	0		
34	8	0	Sales of Supplement	...	68	18	7		
2	10	5	Sales of other Publications	...	3	6	7		
50	0	0	Contribution from Royal Economic Society	...	50	0	0		
441	1	11	Dividends and Interest (gross)	...	449	8	5		
2,836	12	7			2,512	3	2		
					Balance carried to Accumulated Fund: Excess of Expenditure over Income for the year				
—	—	—			123	3	0		

2,836	12	7			2,635	6	2		
21	0	0	Life Compositions	...	52	10	0		
£2,857	12	7			£2,687	16	2		



## APPEN

## BALANCE SHEET AT

[illegible]

*Note.*—No value is placed in the Accounts on (1) Journals and other Publications in stock, (2) Books in Library, and (3) Pictures, Furniture and Equipment.

## DIX B.

31st DECEMBER, 1941

1940				ASSETS.				1941								
£	s.	d.		£	s.	d.		£	s.	d.		£	s.	d.		
				Investments, at cost or under:—												
5,580	0	0		£10,527 12s. 3d. 2½% Consols								5,580	0	0		
1,185	0	0		(Guy Bequest) ... ..								1,185	0	0		
1,299	0	0		£2,236 11s. 3d. 2½% Consols								1,299	0	0		
490	0	0		£1,841 3½% Conversion Loan								490	0	0		
				£500 3½% War Loan ... ..												
800	0	0		£1,169 17s. 6d. 3% Local								800	0	0		
				Loans Stock ... ..												
				£666 4% 2nd Prefd. Stock,												
100	0	0		London and North-Eastern								100	0	0		
				Railway ... ..												
				£266 5% Prefd. Ord. Stock,												
25	0	0		London and North-Eastern								25	0	0		
				Railway ... ..												
<hr/>				9,479 0 0				<hr/>				9,479 0 0				
				(Market value, December												
				31st, 1941, less Interest												
				accrued, £14,303)												
				Interest accrued on Investments												
	101	19	9	(gross) ... ..									101	19	9	
	199	13	4	Cash at Bank and in hand ...									318	9	11	
	63	0	0	Arrears of Subscriptions re-									63	0	0	
	129	14	7	coverable (estimated) ... ..									51	7	9	
	195	0	0	Sundry Debtors ... ..									197	6	9	
<hr/>				10,168 7 8				<hr/>				10,211 4 2				
				Building Fund:—												
				£1,040 5s. 1d. 3½% Conver-												
	917	13	4	sion Loan ... ..									953	3	9	
				(Market value, December												
				31st, 1941, £1,113)												
				Frances Wood Memorial												
				Fund:—												
				£600 4% Preference Stock,												
300	0	0		London, Midland and Scot-								300	0	0		
				tish Railway ... ..												
				(Market value, December												
				31st, 1941, £405)												
	75	17	0	Post Office Savings Bank												
				Deposit ... ..								99	4	2		
				Cash in hand ... ..								1	16	0		
<hr/>				375 17 0				<hr/>				401 0 2				
<hr/>				£11,461 18 0				<hr/>				£11,565 8 1				

## REPORT OF THE AUDITORS

We have examined the foregoing Statement of Income and Expenditure and Balance Sheet with the Books and Records of the Society. We have verified the Investments and Cash appearing in the Balance Sheet. We report that the above Balance Sheet is, in our opinion, properly drawn up so as to exhibit a true and correct view of the state of the affairs of the Society, according to the best of our information and the explanations given to us, and as shown by the Books and Records.

PLENDER, *Chartered Accountant.* Auditor.

C. OSWALD GEORGE } Honorary  
HERBERT W. ROBINSON } Auditors.

Income, at £2,512, was £324 less than in 1940; Annual Subscriptions fell by £110 and *Journal* sales fell by £247, as only three parts of the *Journal* were issued in 1941. Expenditure totalling £2,635 included War Damage Insurance, amounting to £238; other expenditure, at £2,397, was £323 less than in 1940, mainly in the Publication and Distribution Expenses of the *Journal*. There was thus a deficit of £123 in 1941 as compared with a surplus of £116 in 1940. The Accumulated Fund of the Society amounted to £7,434 at the end of 1941.

The Fellows named below (nominated in accordance with Bye-law 14) are recommended for election as President, Council, and Officers of the Society for the Session 1942-43:—

*President*

**Sir William Beveridge, K.C.B., LL.D., F.B.A.**

*Council*

M. S. Bartlett, D.Sc.  
Lt.-Col. William Butler, M.B.  
Harry Campion.  
\*Henry Clay.  
Iris Douglas.  
\*Major P. Granville Edge, O.B.E.  
Sir William Elderton, C.B.E., F.I.A.  
G. W. S. Epps, C.B., C.B.E., F.I.A.  
\*Dorothy P. Etlinger.  
C. O. George, Ph.D.  
R. F. George.  
Sir Gwilym Gibbon, C.B., D.Sc.  
R. G. Glenday, M.C.  
\*P. N. Harvey, F.I.A.  
David Heron, D.Sc.

A. Bradford Hill, D.Sc., Ph.D.  
Leon Isserlis, D.Sc.  
Professor J. H. Jones.  
M. G. Kendall.  
J. M. Keynes, C.B., F.B.A.  
Sir Walter Layton, C.B.E., LL.D.  
\*Sir David Meek, C.I.E., O.B.E.  
Professor E. S. Pearson, D.Sc.  
Professor Arnold Plant.  
\*George Rae, D.Sc.  
\*H. W. Robinson, Ph.D.  
E. C. Snow, C.B.E., D.Sc  
Percy Stocks, M.D.  
Sir Sylvanus Vivian, C.B.  
John Wishart, D.Sc.

Those marked \* were not Members of Council during the preceding Session.

*Honorary Treasurer*

**David Heron, D.Sc.**

### *Honorary Secretaries*

**E. C. Snow, C.B.E., D.Sc.**

**A. Bradford Hill, D.Sc., Ph.D.**

**Leon Isserlis, D.Sc.**

*Honorary Foreign Secretary*

E. C. Snow, C.B.E., D.Sc.

On behalf of the Council,

W. H. BEVERIDGE.

*President.*

E. C. SNOW,

L. ISSERLIS.

A. BRADFORD HILL.

*Hon. Secretaries.*

*June 9th, 1942.*

PROCEEDINGS OF THE ONE HUNDRED AND EIGHTH GENERAL MEETING OF THE  
ROYAL STATISTICAL SOCIETY, HELD AT THE LONDON SCHOOL OF HYGIENE  
AND TROPICAL MEDICINE ON TUESDAY, JUNE 16TH, 1942.

The Chair was taken by the PRESIDENT, Sir WILLIAM BEVERIDGE, K.C.B., LL.D., at 5.0 p.m.

Dr. ISSERLIS, HONORARY SECRETARY, read the notice convening the Meeting.

A ballot was taken for the election of the President, Council, and officers for the Session 1942-43, Miss L. A. Coote and Miss E. A. Barker being appointed scrutineers. As a result, it was announced that all those nominated had been elected to the respective offices.

The Honorary Secretary announced that in accordance with Bye-law No. 9 the Council had ordered the names of 20 Fellows to be erased from the roll of the Society.

The PRESIDENT moved the adoption of the Report of the Council for the Session 1941-42, with Report of the Auditors, Statement of Accounts and Balance Sheet for the year 1941, copies of which had been distributed to those present.

Dr. H. O. HARTLEY seconded the motion which, on being put to the meeting, was carried unanimously.

Mr. G. L. SCHWARTZ proposed a vote of thanks to the President, Council and Officers for keeping the flag of statistical scholarship flying in London in the third year of war. The motion was seconded by Mr. M. RUDD and was carried unanimously.

The PRESIDENT, speaking on behalf of the Council and Officers, expressed his thanks to the Meeting.

The Proceedings then terminated.

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## REVIEWS OF STATISTICAL AND ECONOMIC BOOKS

## CONTENTS.

	PAGE		PAGE
1.— <i>Wolfenden (H. H.). The Fundamental Principles of Mathematical Statistics</i> . . . . .	350	3.— <i>Clark (Colin). The Economics of 1960</i> . . . . .	352
2.— <i>Shirras (G. F.) and Rostas (L.). The Burden of British Taxation</i> . . . . .	351	4.— <i>Henry (Dr. F.). The Theory of Money</i> . . . . .	353
		5.— <i>Elsas (M. J.). Housing Before the War and After</i> . . . . .	354

1.—*The Fundamental Principles of Mathematical Statistics*. By Hugh H. Wolfenden. Toronto: Macmillan Co., 1942.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . xv + 379 pp. \$4.

There are so many books already available on mathematical statistics that when a new one arrives it is well to consider why it has been prepared and what new point of view is presented. In the present case we have a book that has been published for the Actuarial Society of America, and its object is to present the subject in a form suitable for actuaries and other vital statisticians; it includes, therefore, a satisfactory outline of a course in the graduation of mortality and sickness tables in addition to those subjects which are more usually associated with mathematical statistics. The author takes the view that to understand the subject properly the student should "absorb the history of the mental processes which have guided its development," and, appreciating "the distractions which inevitably arise when the many essential discussions and extended mathematical analyses are inserted in the main text," he has given in the first 148 pages a condensed presentation only, so that the principal ideas can be acquired in the first instance, leaving subsidiary questions, mathematical proofs, applications and, to a large extent, the history to be dealt with in subsequent sections which cover about 200 pages. There follow, before we come to the index, 20 pages of bibliography subdivided into two lists, the first of which gives books and papers which the author considers are mainly of historical interest, and the second those he regards as of present value.

The idea is attractive, and the following comments are not intended as adverse criticism, but to indicate the difficulties that arise in any such development, with the hope that they may help when the author is considering future editions of his book. The most obvious difficulty is that when the reader is going through the condensed presentation he is interrupted by references to the later sections, and so is distracted from the story almost as much as if the later matter had been inserted. In any such work, however historically minded an author may be, he is bound to select or his book will become unwieldy and, as soon as any one of us selects, he finds that someone else would have included what he has decided to exclude. Moreover, having decided on his selection, he must bring his historical treatment into alignment. In this connection it may be suggested to anyone reading the book who dissents from the particular selection and bibliography that he should, himself, set down his own selection and his own subdivided bibliography, and he would find that any statistical friend to whom he showed it would be able to pick plenty of holes. Though, therefore, my own choice would have differed from Mr. Wolfenden's, I feel that mine might be just as much open to criticism, and I shall therefore refrain from adverse comment on his selection of subjects and his bibliography, merely pointing out the sort of things that have been excluded.

There is no mention of periodicity, and while correlation, frequency surfaces, confidence and fiducial limits, orthogonal polynomials and analysis of variance

are mentioned, they are not discussed in detail, though references are given to other works where the student can obtain information. Largely, I think, because his approach to the subject is algebraical, Mr. Wolfenden, in his section on applications, gives little guide as to how arithmetical work should be done, and his numerical examples are scanty, though here also he gives references to books and papers where examples and help can be found. Mr. Wolfenden has had much experience of teaching the subject to actuarial students and, no doubt, he expects anyone using the book to have a tutor who will set arithmetical examples. As the result of experience in using the book and of further research, there will be alterations in any future edition, and the opportunity would be taken to correct one or two slips, the most important of which is that the author appears to have overlooked, in connection with "Student's"  $t$ -test, that "Student" assumes that the observed sample is all that is known except that the parent population is normal, and consequently it is unnecessary to insist on an unexceptional value of  $s$ .

The book is excellently printed and well got-up. We look forward to its being of great help to those for whom it is intended. W. P. E.

2.—*The Burden of British Taxation.* By G. Findlay Shirras and L. Rostas. Cambridge University Press.  $8\frac{3}{4}'' \times 5\frac{1}{2}''$ . xiii + 240 pp. 15s.

There has in recent times been much criticism of attempts to measure the burden of taxation, and there seems a good deal to be said for discontinuing altogether the use of the word "burden" in connection with taxation, or at least with the gross amount of taxation paid by an individual and certainly with the gross amount paid by a nation.

The authors of the book under review try to avoid this difficulty by issuing the warning that their "estimates relate solely to the burden placed on the citizen by the finances of the State; they take no notice of the advantage he derives. Before any judgments in equity are entered, both sides must be considered." In spite of this warning, however, there is little doubt but that their figures will be used as the basis of judgments in equity, and for comparison with the "burden" in earlier years. In fact, two of the main purposes, apparently, of these very intricate calculations is to permit comparison with similar calculations such as those of the Colwyn Committee, and the completion of further calculations and diagrams to show where and when the scale of taxation is progressive or regressive.

Both give rise to serious doubts. Comparison of these figures and diagrams with earlier results will obviously lead to wrong conclusions unless the fullest allowance be made for the changing levels of prices and wages. Clearly the man with an income of £100 in 1903 or 1913 is in no way comparable with the man enjoying the same income in 1942.

And in viewing the diagrams, the authors' warnings may well be emphasised and extended. First of and above all, of course, there is no allowance whatever for the benefits of Government expenditure, and this not only falsifies but may completely reverse the picture, especially in the oft-quoted case of the man with the large family; a particular example of this is that food taxes are included but food subsidies are ignored. Secondly, and this makes one again wonder if the authors are showing us a photographic negative rather than the finished print, no account whatever is taken of post-war credits which will particularly affect the "burden" on the poorer classes and larger families. Thirdly, and this will seem strange to those who agitated for the raising of the income limit for voluntary subscribers, all compulsory social insurance contributions are regarded and included as part of the tax "burden," a fact which explains some of the strange kinks in the curves. Fourthly, the lower income limit of £100 adopted as a basis, which substantially affects the look of many of the curves, illustrates some of the difficulties of this type of calculation. Here we are asked to consider the case of a man with wife and two children who earns only £100 a year, and although only a "moderate smoker and drinker" spends more than a quarter of his income on alcohol and tobacco. It would be interesting to know where,

in 1942, such men with such incomes are to be found, and in what respects they are typical. They are certainly different from the £100 a year man of 1903 or 1913. Finally, the authors' declaration that war-time taxation has not changed the regressive character of the "burden" on incomes below £250 per annum seems to need further qualification, since even with the figures given, it is not true of what the authors call the "unavoidable burden" on a single man, and, if we ignore the dubious case of the £100 a year man, it is not true for the married man without children.

Death duties have long been recognised as a stumbling block for calculators of tax burdens. The authors in this case have avoided the difficulty by handing it over to Mr. Kaldor, who has contributed a characteristically ingenious attempt to estimate their annual net burden by calculating the reductions, owing to death duties alone, in the tax-paid income stream from estates of different sizes. After making various startling assumptions, such as rates of interest, of income tax, of super tax and of death duties that remain at their present level for ever, he reaches even more startling conclusions. With zero net saving, the proportionate burden of the death duties is declared to reach its maximum on estates of £50,000, when the total burden is estimated to be only £1,803; on estates of £250,000, it is a paltry £6,506; while on estates of £500,000, it is not only relatively but absolutely lower at £5,754. Furthermore, these small sums are alleged to cover the burden of the death duties for ever. The annual burden is then calculated very simply by taking 4 per cent. of the total burden, and this presumably represents the annual burden in perpetuity, in which case the annual burden of the death duties would sooner or later immensely exceed the then capital value of the estate. Be that as it may, the annual burden of the death duties on estates of £125,000, £250,000, £500,000 and £1,250,000 is said to be, respectively, only £156, £260, £230, and £256 per annum, or 3.14, 2.61, 1.15, and a mere 0.51 per cent. of their present annual revenue! So that in spite of steeply progressive rates of the death duties, the burden of the duties on the larger estates is, according to these calculations, steeply regressive, a truly startling if not to everyone a completely conclusive conclusion.

Finally, it may be said that the book shows throughout evidence of careful and conscientious work, of accurate computation, and avoidance of the many technical pitfalls which beset workers in this field. It is to be hoped the authors will find time to extend their researches to the sphere of public expenditure, and, by estimating the benefits derived by various types of taxpayers or sections of the income pyramid, give us an intelligible and completed picture of the net "burden" of public finance as between different classes and different periods.

C. O. G.

3.—*The Economics of 1960*. By Colin Clark, M.A. London: Macmillan. 1942. 8½" × 5½". x + 118 pp. 8s. 6d.

The author announces that this book has the modest and attainable aim of describing the state of economic affairs which may reasonably be expected in 1960. Mr. Clark considers that political and social upheavals, however violent, have surprisingly little effect on the long-term trend of economic events. He illustrates this contention by using data which he worked up in his earlier book on *Conditions of Economic Progress*, and provides a diagram showing for eight different countries the real income per person in work (in international units per 2,500 hours' work) from about 1860 onwards in the case of five countries and from about the beginning of the century for the other three.

The effects of the great depression of the early 1930's he considers to be almost invisible and those of the war of 1914-18 to be comparatively slight. After each event, which seemed of major economic importance to those living in the midst of it, the upward trend of the curve was continued. Anybody without knowledge of the history of 1914-20 and 1930-33 would not, from a survey of the curves, have suspected that events which seemed of catastrophic dimensions in the economic life of the time had occurred. It appears from this to be justifiable to look ahead about twenty years (Mr. Clark's introduction was

written in May, 1941) and to provide a picture of the economic position in 1960. Mr. Clark then proceeds to do this, and in particular to forecast productivities per head in primary, secondary and tertiary industries.

The argument throughout the book is much condensed, and requires such frequent reference to the earlier work and other sources that it is hardly possible, in present circumstances, to examine the validity of the various stages of the argument as they deserve. In calling attention to the contents of the book, therefore, it must suffice to make brief comments on one section, and not by any means the most important one, of Mr. Clark's work, namely, the reliability of forecasts of population twenty years ahead. Writing at the time when the slaughter of men of reproductive ages is greater than at any time in history, it seems difficult to believe that curves based upon facts as they may be seen some time after 1960 will actually show that the set-back in the period 1939-? will have had only a small permanent effect on the general economic trend.

It happens that about 30 years ago some similar, though much less ambitious, estimates were made of the state of affairs 20 years ahead, and in particular, at the request of the Dominions Royal Commission, estimates were made, by the most suitable methods then available, of the aggregate population of Great Britain, Ireland, Canada, Australia and New Zealand. In 1911 these self-governing countries of the Empire had a total population of 57,890,000, and the estimate made of the corresponding population in 1931 was 69,780,000. The figure available after the censuses of 1931 (or thereabouts) was 67,860,000. Thus the estimates were in error to the extent of 3 per cent. in the actual population and of 19 per cent. in the increase of population over the 20 years.

The estimates were made for each sex and in age groups, and no doubt the discrepancy between forecast and subsequently determined fact in the groups was proportionately greater than in the total. Such a result can hardly be considered a triumph for the forecaster, though it is impossible to say to what extent the discrepancy was due to the intervention of four years of war. The disruptions to normal population growth which occurred in the British Empire between 1911 and 1931 (of which, of course, the forecaster had no inkling) will, to historians writing in the 1960's, no doubt seem small compared with those in the 20 years or so prior to 1960.

As the forecast was not particularly good for the earlier period, we cannot feel much confidence about forecasts made over a period including 1940-42, and it may be that the remaining 18 years will have some more events in store which will be even more inimical to accuracy in forecasting population growth.

But the merit of Mr. Clark's book does not depend upon whether or not his many forecasts will be accurately fulfilled. It touches upon many economic problems of importance at the present time, and the discussion of these is instructive whatever the state of the world in 1960 may ultimately turn out to be.

E. C. S.

4.—*The Theory of Money*. By Dr. F. Henry. London: P. S. King & Son. 1942. 8½" × 5½". 101 pp. 7s. 6d.

This delightfully arrogant little book will never earn sufficient praise for its unusual clarity, since that very clarity makes it so undeservedly easy for the reader to pick holes in the argument.

In setting out to destroy the "veil" of money, the author obviously intends to eliminate the "veil" of monetary theories as well. Indeed, he believes that: "Anyone who needs more than about a dozen pages to express what money is, must be wrong. If this treatise contains more than that number, it is chiefly because . . . I have to say a great deal about what money is not, in order to be able to say what money is."

To carry out this ambitious project we are asked to consider all the existing real wealth, consisting of "visible and tangible things," and then to examine the superimposed structure of rights and liabilities; the latter is of small importance, and if all titles were dissolved, the total wealth would be unaffected.



"Money is born out of the act of renunciation which everyone performs who leaves his tangible wealth with another and takes in its stead a *title* on that wealth." "Everyone mingling in daily economic life, if he has enough ability, can increase his claim, can make money." "The state cannot make money since . . . whatever the state may do by arranging the economic life of the nation it creates nothing whatsoever." "If the state were to print and circulate new money tokens . . . this would bring with it a new distribution of the 'total available' of visible and tangible things." Money-makers may increase their own share to the detriment of others, or may not, according to the effect their activity has on the available wealth. A few pertinent remarks put Gold back in its place. Others betray the author's weakness for making startling statements: "The most successful people are those who can 'stand a lot' and still be on the right side of the allowed and disallowed." "Capitalism is a term of insult with which the smooth running of the economic life of the nation is besmirched by those who fail to find their proper place in it."

Now all this may be amusing, but it certainly is not economics. Indeed, one cannot help wondering how a theory of money could ever be attempted in *real* terms. It may be possible to visualize a banknote as a kind of cloakroom ticket representing a tangible thing we had previously given up. But it must be remembered that it is precisely someone *else's* coat we desire to be given back in exchange. If all titles, *i.e.* all money, could be abolished, the real wealth would not be the same since the services performed by money can hardly be dispensed with. Stability, universal acceptance, liquidity are some of these purely monetary qualities which have, apparently, escaped the author's attention.

G. A. B.

5.—*Review of Housing Before the War and After.* By M. J. Elsas. Published by P. S. King and Staples, Ltd. 69 pp. 5s.

Dr. Elsas has written an able survey of the housing situation before the war and, so far as present uncertainties permit, of the housing problems likely to face us at its conclusion. Although his book is published under the auspices of the Population Investigation Committee, one of its most useful contributions is to warn against over-emphasis on the influence of the population factor on the demand for houses. The knowledge a decade ago that the number of families would increase, while the total population fell, did not make it possible to prognosticate the future demand for houses. Dr. Elsas makes it plain that family income, credit facilities and other economic factors had a much more direct impact on house-building in the inter-war period. The importance of the demographic factor now is not in assessing the probable demand for houses after the war, but in gauging the needs of the population on given minimum standards.

This reviewer is of the opinion that the question of minimum housing needs is paramount. The purpose of the Beveridge report is to secure for everybody a financial minimum, albeit a financial minimum related to the level of prices. But if the principle of a financial minimum is accepted, the State is obliged, as an inescapable corollary, to see that the actual physical goods, including houses, are provided. And just as in war-time the statuses of childhood, adolescence, pregnancy and sickness are rightly considered alone to be relevant to a priority supply of milk, so at the conclusion of hostilities minimum housing needs will have to be assessed in relation to the number, size and age distribution of families. In assessing these needs—which it may be hoped Dr. Elsas will be able to do again and more precisely, when the situation becomes clearer—it is obvious that even to regain the standards of 1939 a considerable building programme will be necessary. During the war slum clearance and the abatement of overcrowding have been suspended, old houses have not been replaced and repairs have been minimal. War losses will have been substantial, although not as high as 2,750,000, the figure of bomb-damaged houses in England and Wales given by the Minister of Health, which does not distinguish between slightly damaged and readily repairable houses and those more severely damaged. On the other side of the account, the number of adults, and therefore of families, will almost

certainly be greater than in 1939, even if many more lives are destined to be lost before final victory is achieved. And even if 1939 standards are regained, it must be remembered that a substantial number of families were sharing houses in that year and that the rate of replacement was not high. According to one estimate quoted by Dr. Elsas there are over a million houses in this country which were built before the founding of the United States of America.

How easy is it going to be to organize the building effort which will be needed? What will be the cost? Dr. Elsas is pessimistic. He envisages a disintegrated building trade with a less efficient personnel than before the war. On the other hand, he sees the possibility of a low rate of interest. This reviewer is more optimistic. New methods can and must be applied to house-construction. Pre-fabrication had already achieved successes in 1939. America's wonder tycoon, Henry Kaiser, believes that houses can be built like ships, and in a recent address urged a post-war construction programme for the United States of nine million houses. Surely the industrial leadership and production technique of this country, which are now devoted to supplying us with vast quantities of war weapons, can be turned at the armistice to the provision of cheap houses? And, if we make up our minds, can we not train men to build houses by the same mass methods as we train new recruits to the armed forces and the munitions industry?

H. G.

## STATISTICAL NOTES

## 1. BRITISH OFFICIAL STATISTICS

COMPARED with the average of general *wholesale prices* during 1941, there was a rise during 1942 of about 4·6 per cent., according to the Board of Trade index-number, which averaged 159·6 in 1942 and 152·6 in 1941 (average in 1930 = 100). The rise was principally due to the group of cereals, which showed an average advance of over 25 per cent., owing chiefly to the high prices prevailing for English malting barley during the first half of the year and an increase (19½ per cent.) in the price of flour to bread-bakers which took place in September 1942. There were also smaller advances in the prices of fresh meat in March and December, of bacon in October, and of butter in November. Egg prices were reduced about 20 per cent. in April, and there was a fall of about 25 per cent. in the price of potatoes, due chiefly to the subsidy introduced for the purpose of encouraging consumption. There was also a small reduction in milk prices. The largely increased duty on tobacco caused the price to advance about 50 per cent. from the middle of April. There were also appreciable advances in the prices of coal, chemicals and oils and textiles other than wool, but metal prices remained fairly stationary throughout the year.

Compared with the end of 1941, prices in December 1942 showed an over-all advance of 3·5 per cent., food prices having advanced about 5·7 per cent. and prices of industrial materials, etc., about 2·5 per cent. There was a slight decrease in the prices of basic materials generally (except fuel), and an advance of building material of 4·2 per cent.

During the fourth quarter of 1942 the index-number advanced about one and a half per cent., the food and tobacco groups rising 3·2 per cent. and those for industrial materials and manufactures 0·6 per cent. Within the groups there were increases in the prices of wheat flour and bread (operating from 20 September), bacon (October) and fresh meat (December), palm-kernel and ground-nut oil (September 28), and in jute and paint and soap.

Date	Total Food	Total not Food	All Articles	Basic Materials (excluding fuel)	Intermediate Products	Manufactured Articles	Building Materials
Sept. 1942 ... ..	154·1	161·4	159·1	167·3	170·7	154·0	147·3
Oct. „ ... ..	155·7	162·0	160·1	169·0	171·0	154·4	147·5
Nov. „ ... ..	158·1	162·2	161·0	169·4	171·0	154·5	147·6
Dec. „ ... ..	159·0	162·4	161·5	169·9	171·2	154·6	147·7
Dec. 1941 ... ..	150·5	158·4	155·9	170·5	167·7	150·3	141·8
„ 1940 ... ..	144·5	150·4	148·6	158·2	160·7	144·3	132·8
„ 1939 ... ..	118·1	124·3	122·3	135·0	125·0	122·0	110·3
Aug. „ ... ..	90·4	102·2	98·1	94·5	104·0	108·7	104·1
Percentage increase in December 1942 over—							
Dec. 1941 ... ..	5·7	2·5	3·5	0·4*	2·1	2·9	4·2
„ 1940 ... ..	10·0	8·0	8·7	7·4	6·5	7·1	11·2
„ 1939 ... ..	34·6	30·7	32·1	25·9	37·0	26·7	33·9
Aug. „ ... ..	76·0	58·9	64·6	79·9	64·4	42·2	41·9

\* Decrease.

The preceding table gives for the months September to December 1942 the Board of Trade index-numbers of wholesale prices with the increases of the prices at December 1942 over those at the end of 1939, 1940 and 1941, and those current at the beginning of the war.

It will be seen from the above that the increase in prices during the years 1941 and 1942 was not on the whole very marked, and that the very considerable increases in nearly all articles since the commencement of the war occurred during the sixteen months from August 1939 to December 1940. The most striking increases over the whole period of the war were in the food and tobacco group (76.0 per cent.), and in the group of basic materials (excluding fuel), which advanced 79.9 per cent. Cereals accounted for a large proportion of the increase in the food and tobacco group, and the prices of these were in December 1942 124 per cent. in advance of those in August 1939. The industrial group showing the smallest advance since the beginning of the war was that of the non-ferrous metals, which have increased only about 25 per cent., but the prices of these metals have been fixed and their distribution controlled by the authorities during nearly the whole of the period.

The figures of some other British index-numbers of wholesale prices together with that prepared by the United States Bureau of Labor are given below.

Date	Board of Trade (1930 = 100)	<i>Economist</i> (1927 = 100)	<i>Statist</i> (1866-77 = 100)	<i>The Times</i> (1913 = 100)	United States Bureau of Labor (1926 = 100)*
Sept. 1942 ... ..	159.1	112.8	149.7	176.3	99.3
Oct. „ ... ..	160.1	111.7	150.4	176.7	99.7
Nov. „ ... ..	161.0	111.8	151.3	176.4	100.0
Dec. „ ... ..	161.5	112.7	152.2	176.8	100.6
Dec. 1941 ... ..	155.9	108.5	146.5	171.7	93.1
„ 1940 ... ..	148.6	100.9	134.5	165.2	79.8
„ 1939 ... ..	122.3	91.7	120.1	142.5	79.0
Aug. „ ... ..	98.1	70.3	90.4	114.5	74.8
Percentage increase in De- cember 1942 over—					
Dec. 1941 ... ..	3.5	3.9	3.9	3.0	8.1
„ 1940 ... ..	8.7	11.7	13.2	7.0	25.1
„ 1939 ... ..	32.1	22.9	35.1	24.1	27.3
Aug. „ ... ..	64.6	60.3	68.4	54.4	34.5

\* Mean of weekly prices.

The difference in the increases shown by the various British index-numbers over the period August 1939 to December 1942 is not very considerable when it is considered that the index-numbers of the three newspapers are based to a greater extent on the prices of articles that can be classed strictly as raw materials. Moreover, the Board of Trade number is based on the average of prices throughout each month, whereas the remaining numbers are based on prices at or near the end of each month. The American index-number, which covers about 800 commodities, is based on the average of the weekly prices during each month.

During 1942 there has been little general change in the *cost-of-living* index-number of the Ministry of Labour and National Service, prepared to show the changes in the retail prices of articles of working-class consumption. Retail prices of food at January 1, 1943, showed a rise of less than 1 per cent. compared with those current at the beginning of 1942. There have been reductions in the prices of sugar, eggs and potatoes, and an increase in the price of bread of 1d. per 4 lbs. and a corresponding increase in the price of flour of 1½d. per 7 lbs. As regards clothing, there was, during the latter half of 1942, a considerable decline in the index-number, due to the increased purchases of "utility" apparel and cloth and to the removal of the Purchase Tax from such goods. Prices of utility clothing of all kinds are "appreciably lower than those of non-utility goods of corresponding quality." Prices of fuel and light increased about 6 per cent. during the year, owing principally to advances in the price of coal, and there has been a gradual rise in the prices of domestic ironmongery, glass, pottery, brushes and soap. Prices of tobacco and cigarettes rose in April 1942 to cover the increased duties, and were estimated to amount to an increase of about 37 per cent. As compared with September 1, 1939, there has been an advance of rather more than 28 per cent. in the general cost-of-living index-numbers. Food prices have advanced 19 per cent., clothing prices 78 per cent., prices of fuel and light 34 per cent., and those of other items \* about 50 per cent.

The following table gives the index-numbers for the various groups for the later months of 1942.

(Prices at July 1914 = 100)

Date	Food	Rent and Rates	Clothing	Fuel and Light	Other items *	Total
Sept. 1st, 1942 ... ..	160	164	395-400	240	265	200
Oct. 1st, ,, ... ..	162	164	390	241	266	200
Oct. 31st, ,, ... ..	163	164	385	241	267	200
Dec. 1st, ,, ... ..	164	164	375-380	241	268	200
Jan. 1st, 1943 ... ..	164	164	370	244	268	199
Jan. 1st, 1942 ... ..	163	164	400	230	233	200
Sept. 1st, 1939 ... ..	138	162	205-210	180-185	180	155
Increase per cent. in Jan. 1943 over—						
Sept. 1st, 1939 ... ..	19	1	78	34	50	28

\* Soap, brushes, pottery, domestic ironmongery, fares, tobacco, etc.

*Changes in rates of wages* during 1942 resulted in a net increase of over £1,600,000 in the weekly full-time rates of about 6½ million workpeople, compared with a net increase of £2,100,000 to 8,000,000 workpeople in 1941 and £2,200,000 to about the same number in 1940. These figures are exclusive of changes in the wages of agricultural workers, Government employees, domestic servants, shop assistants and clerks. It is estimated by the Ministry of Labour that at the end of 1942 the average level of full-time weekly *rates of wages* in all industries (including agriculture) for which information is available was about 5 per cent. higher than in 1941 and about 32 or 33 per cent. higher than at the beginning of the war. There has been since the war a marked increase in *average earnings*, resulting from fuller employment, overtime working and the extension of the

system of payment by results, and statistics published in the *Ministry of Labour Gazette* for December 1942 show that average earnings in industry have increased to a considerably greater extent than have the rates of wages.

The statistics referred to are the results of a census taken by the Ministry of Labour of the *average earnings* of workpeople in practically all industries except coal-mining and railway service in the pay week ended July 18, 1942. The returns received covered 55,400 establishments, and the number of workpeople included in the returns was rather more than six and a quarter millions. The returns included foremen, transport workers, warehousemen, etc., but travellers, clerks, typists and salaried persons generally were excluded, as also were shop assistants and outworkers working at home on materials supplied by the employer. Similar censuses of earnings had been obtained by the Ministry for October 1938, July 1940, July 1941 and January 1942, some of the results of which were noticed in Part IV of the *Journal* for 1941, pp. 390-2.

The following table shows the average weekly earnings in October 1938 and July 1942 in sixteen industrial groups, together with the percentage increases over the earnings in October 1938 of the earnings at each of the four dates since the war. (Between October 1938 and the commencement of the war there were few changes in wage-rates.)

Industry Group	Average weekly earnings in - -				Percentage increase over Oct. 1938 of average weekly earnings in -			
	Oct. 1938		July 1942		July 1940	July 1941	Jan. 1942	July 1942
	s.	d.	s.	d.	Per cent.	Per cent.	Per cent.	Per cent.
Iron, stone, etc., mining and quarrying ... ..	56	8	84	4	22·1	38·8	32·6	48·8
Treatment of non-metalliferous mining and quarry products ...	61	0	91	1	26·1	38·2	33·3	49·3
Brick, pottery, glass ... ..	47	8	71	8	19·8	35·8	35·8	50·3
Chemical, paint, oil, etc. ... ..	55	0	81	0	25·3	35·7	35·6	47·3
Metal, engineering and shipbuilding ... ..	59	8	99	6	42·3	49·2	55·9	66·8
Textiles ... ..	37	10	59	3	29·5	37·7	43·0	56·6
Leather, fur, etc. ... ..	46	9	68	7	16·8	31·4	37·6	46·7
Clothing ... ..	35	0	51	2	12·9	27·9	29·5	46·2
Food, drink and tobacco ... ..	47	0	66	2	15·4	29·4	29·6	40·8
Woodworking ... ..	51	10	74	1	16·7	31·4	27·8	42·9
Paper, printing, stationery, etc. ...	57	7	73	8	1·6	17·9	20·5	27·9
Building, contracting, etc. ... ..	61	2	94	7	32·6	47·6	27·7	54·6
Other manufacturing industries ...	46	6	74	6	31·0	40·6	47·3	60·2
Transport, storage, etc. (excluding railways) ... ..	65	6	90	0	20·6	25·6	28·8	37·4
Public utility services ... ..	59	8	76	4	10·6	20·2	22·9	27·9
Government industrial establishments ... ..	70	6	95	0	33·9	26·8	27·3	34·8
All the above ... ..	53	3	85	2	29·9	42·4	46·0	59·9

The earnings of men, women, boys and girls were separately stated, as well as those of women part-time workers, which were taken as being equal to half the earnings of a full-time worker. The estimated increases in the average level of *rates of wages* for a full ordinary week's work in the industries covered by these enquiries was stated to be 10 or 11 per cent. in July 1940, 18 per cent. in July 1941, 22 per cent. in January 1942 and 24 per cent. in July 1942 over the

rates current in October 1938. The difference between these increases and the increased percentage *earnings* shown in the table are due chiefly to fuller employment, longer working hours, extension of night-shift working, extensions of systems of payment by results and changes in the proportions of men, boys, women and girls employed in different industries and occupations. The severe weather conditions prevailing in January, 1942, account for the diminished percentage increases in earnings in some industries, as compared with July, 1941.

The earnings of men, women, boys and girls are shown separately in the following table, together with the percentage increases over those in October 1938 at the various dates. The earnings are computed on the basis of the total numbers of workpeople employed in the different industries at the dates named.

Date	Men (21 years and over)		Youths and Boys		Women (18 years and over)		Girls		All workers	
	Average weekly earnings									
	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>
Oct. 1938 ... ..	69	0	26	1	32	6	18	6	53	3
July 1940 ... ..	89	0	35	1	38	11	22	4	69	2
„ 1941 ... ..	99	5	41	11	43	11	25	0	75	10
Jan. 1942 ... ..	102	0	42	6	47	6	26	10	77	9
July 1942 ... ..	111	5	46	2	54	2	30	3	85	2
Percentage increase compared with October 1938										
	Per cent.		Per cent.		Per cent.		Per cent.		Per cent.	
July 1940 ... ..	29.0		34.5		19.7		20.7		29.9	
„ 1941 ... ..	44.1		60.7		35.1		35.1		42.4	
Jan. 1942 ... ..	47.8		62.9		46.2		45.0		46.0	
July 1942 ... ..	61.5		77.0		66.7		63.5		59.9	

*Unemployment* continued to decrease during the last quarter of 1942 and the total number of workpeople remaining on the registers of the Ministry of Labour and National Service at the middle of December 1942 was 86,824, or 17,284 less than in the middle of September. Of these 49,920 were men, 7,133 youths and boys, 23,313 women and 6,458 girls. Apart from those who were temporarily suspended (2,023) and those who ordinarily seek employment by casual labour, *e.g.*, dock labourers (2,858), there remained only a total of 81,943 wholly unemployed. Most of these are workpeople in the process of changing jobs or occupations, and the demand for labour remains very strong in almost all directions. In addition to the number of men and women recorded as unemployed, there were at the middle of December 1942, 22,592 men who had been classified by interviewing panels as unsuitable for ordinary industrial employment and 895 women unsuitable for normal full-time employment. Of the women wholly unemployed, 925 had been classified as unable for good cause to transfer to another area. No figures are available giving the numbers now in industry, but the proportion recorded as unemployed cannot be as much as one half of one per cent. The figures for recorded unemployment have been published at monthly intervals since the beginning of 1932 (previously they had been issued weekly). In the future (*i.e.*, after the issue of the January 1943 figures) publication will take place only quarterly.

The following table gives the numbers recorded as unemployed from September 1942.

Date	Wholly Un-employed	Temporarily Stopped	Persons normally in Casual Employment	Total	Males	Females
Sept. 14th, 1942 ...	98,662	2,709	2,737	104,108	67,832	36,276
Oct. 12th, „ ...	96,017	2,196	2,867	101,080	64,872	36,208
Nov. 16th, „ ...	90,662	2,040	2,740	95,442	63,102	32,340
Dec. 14th, „ ...	81,943	2,023	2,858	86,824	57,053	29,771
Dec. 8th, 1941 ...	165,224	13,261	9,869	188,354	106,292	82,062
„ 9th, 1940 ...	541,900	141,848	21,531	705,279	370,296	334,983
„ 11th, 1939 ...	1,170,798	143,065	47,662	1,361,525	933,402	428,123
Aug. 14th, „ ...	968,108	211,978	51,606	1,231,692	947,099	284,593

During 1942 there were 1,281 *trade disputes* involving stoppages of work, and the total number of working days lost by these disputes at the establishments where the disputes occurred was 1,527,000. The total number of workpeople affected was about 455,000, of whom about 106,000 were not directly involved, but were thrown out of work at the establishments in consequence of the disputes. Most of the stoppages were at individual works and were of short duration, but the total number of working days lost was in excess of the number lost in 1941 (1,080,000). More than half of the working days lost (837,000) occurred in the coal-mining industry, in which there were 504 disputes and 249,900 workpeople involved. These were, however, mostly at individual pits, and were on questions of wages. There were 233 disputes in the engineering trades, involving 81,700 workpeople with 285,000 working-days lost, and 111 disputes in shipbuilding, involving 42,000 workpeople and 192,000 working days lost. These three industries covered more than four-fifths of the workpeople engaged in trade disputes and of the working days lost.

## 2. OTHER STATISTICS

The Statistics of Failures in the United Kingdom and Ireland, issued annually by Mr. Richard Seyd, show a total of 548 for the year 1942, compared with 1,020 in 1941 and 5,550 for 1938. Of the 548, 32 occurred in Eire. The 516 in Great Britain and Northern Ireland were distributed as follows: 36 in the Wholesale Trades, 363 among retailers, etc., and 149 among professional, financial and private persons (the corresponding figures for 1941 were 70, 748 and 205 respectively). Failures of private persons were 86 in 1942 and 91 in 1941. The highest number in the wholesale trades list was 4 (commission agents, and also engineers, metal merchants, etc.). In the retail trades section, clerks and commercial travellers come first with 39 failures (41 in 1941); next in order are grocers and provision merchants 34, builders 29, publicans 22, plumbers, painters, etc. 16, drapers and hosiers 15. There were 24 failures among farmers.

In addition to the failures 869 Limited Companies were wound up voluntarily on account of liabilities (778 in England, 63 in Scotland, 7 in Northern Ireland, 21 in Eire); of these 53 were in the wholesale etc. trades, 7 among professional and private persons.



# STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS

## UNITED KINGDOM—

*Agenda*—Vol. 1, No. 4—The new deal: *D. Mitrany*. The Jewish problem: *Morris Ginsberg*. Some aspects of postwar problems in the Netherlands East Indies: *Charles O. van der Plas*. Planning for cheaper electricity: *M. W. Humphrey Davies*. The housing of the working class, London, 1937: *M. A. Abrams*.

*Annals of Eugenics*—December 1942—The war and the problem of ageing: *V. Korenchevsky*. The theory of confounding in factorial experiments in relation to the theory of groups: *R. A. Fisher*. Some combinatorial theorems and enumerations connected with the numbers of diagonal types of a Latin square: *R. A. Fisher*. Completely orthogonal  $9 \times 9$  squares. A correction: *R. A. Fisher*.

*Annals of Mathematical Statistics*—September 1942—Additive partition functions and a class of statistical hypotheses: *J. Wolfowitz*. Theory of testing composite hypotheses with one constraint: *H. Schaffé*. Problem of multiple matching: *I. L. Battin*. Choice of the number of intervals in the application of the Chi Square test: *H. B. Mann* and *A. Wald*. Linear restrictions on Chi-Square: *F. E. Satterthwaite*. Observations on analysis of variance theory: *Hilda Geiringer*.

### *The Banker*—

December 1942—Multilateral clearing through Berlin: *Paul Einzig*. The relief of unemployment: *E. A. Grant*.

January 1943—Beveridge finance. International lending after the war: *David Sachs*. The banking year at home.

February 1943—German financial control of Europe: *Paul Einzig*. Banking in France since 1940: *Paul Bureau*. The post-war scrambling: *David Sachs*. The banks in 1942.

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*Eugenics Review*—October 1942—Infant and maternal mortality: *R. M. Titmuss*.

### *Institute of Statistics, Oxford, Bulletin*—

Vol. 5, No. 1—Labour in the war industries in Britain and U.S.A. A. Sources of manpower in the British war sector: *M. Kalecki*. B. The U.S. war effort in terms of manpower: *J. Steindl*.

Vol. 5, No. 2—The shipping balance: *T. Balogh*. Earnings of work-people in 1938 and 1942: *J. C. Nicholson*. Taxation of tobacco, beer and cinema attendances: *J. Goldmann*.

*Manchester Statistical Society, Transactions*—Session 1941–42—Financial Control as an instrument of economic policy: *W. F. Crick*. Post-war trade agreements: *E. Raymond Streat*. Local Authorities and housing subsidies since 1919: *Marian Bowley*. Statistical methods as aids to production efficiency: *B. P. Dudding*. Changes in labour conditions during the past 40 years.

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- Public Administration*—October–December 1942—British restaurants in the north-western division: *Maud Gates, O.B.E.* The Civil Service, yesterday and to-morrow: *E. N. Gladden.*
- Review of Economic Studies*—Winter 1942–43—National income in the United Kingdom and the United States of America: *Richard Stone.* Production cost indices: *L. M. Court and H. G. Lewis.* The quantitative aspect of the British population problem—Survey: *E. Grebenik.* Indirect taxes, subsidies and the cost-of-living index: *Tibor Barna.* Rationing and index numbers: *J. H. Nicholson.*
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- Statistical and Social Inquiry Society of Ireland, Journal of*—Vol. XVI, 1941–42—Regional life tables: *Colm. A. Barry.* Calendar reform: *E. K. Eason.* Financial results on sixty-one West Cork farms in 1940–41: *M. Murphy.*

## UNION OF SOUTH AFRICA—

- South African Journal of Economics*—
- September 1942—World economic solidarity: *Professor S. Herbert Frankel.* Social security: *Professor H. R. Burrows ; I. G. Halliday ; P. J. deVos ; and R. H. Smith.*
- December 1942—The excess profits duty in South Africa: *Basil S. Yamey.* The secular stagnation thesis and the problem of economic stability: *D. G. Franzsen.* Fundamentals of economic policy in the Union: *Professor H. R. Burrows ; Professor C. S. Richards.*

## UNITED STATES OF AMERICA—

- Actuarial Society of America, Transactions*—Vol. XLIII, Part two, 1942—On the formulae for calculating the “Exposed to Risk” in constructing mortality and other tables from the individual records of insured lives: *Hugh H. Wolfenden.*
- American Economic Review*—December 1942—Price control in outline: *D. D. Humphrey.* Price freezing under the O.P.A.: *Victor Abramson.* The exchange equalization account of Great Britain: *L. M. Pumphrey.*
- American Statistical Association, Journal of*—December 1942—Cost of living indexes in wartime: *Faith M. Williams, Frances R. Rice and Emil D. Schell.* Selective service’s medical statistics program: *Oliver H. Folk.* Preliminary population estimates based on ration book applications: *T. J. Woofter, Jr.* Recent developments in correlation technique: *Paul S. Dwyer.* Use of the discriminant function for more than two groups: *Besse B. Day and Marion M. Sandomire.* Distribution of income in 1935–36: *Rufus S. Tucker.* A punched card technique to obtain coefficients of orthogonal polynomials: *Lila F. Knudsen.* Errors in card punching: *W. Edwards Deming, B. J. Tepping and Leon Geoffrey.*
- Econometrica*—January 1943—The statistical implications of a system of simultaneous equations: *Trygve Haavelmo.* La hiérarchie des besoins et la notion de groupes dans l’économie de choix: *René Roy.* Demand elasticities reviewed: *J. Marschak.*

## UNITED STATES OF AMERICA—Contd.

*Harvard Business Review*—

*Autumn number 1942*—Postwar boom or collapse: *Sumner H. Slichter*.  
The world's food position and outlook: *J. S. Davis*. Limiting executive salaries in wartime: *J. C. Baker*.

*Winter number 1943*—Five postwar trade problems: *Alonzo E. Taylor*.

*Journal of Experimental Education*—*September 1942*—Factors associated with the achievement of High School pupils of superior intelligence: *J. W. Musselman*.

*Quarterly Journal of Economics*—*November 1942*—The concept of unemployment: *Clarence D. Long*. Potash prices and competition: *Samuel P. Hayes*. Production and the probabilities of cost: *A. J. Nichol*. Transport development and building cycles: *Walter Isard*. The behaviour of money national income under inflationary conditions: *A. Smithies*.

*Review of Economic Statistics*—*November 1942*—A neglected cycle: The transport-building cycle: *Walter Isard*. Some problems in rationing meats: *J. J. Kaplan*. The temporal stability of consumption patterns: *W. Allen Wallis*. A method for estimating the size distribution of a given aggregate income: *Edward Ames*.

*Social Research*—*November 1942*—A reconsideration of the law of supply and demand: *Adolph Lowe*. On the economics of war finance: *Alfred Kahler*. Plan for a postwar world clearing bank: *Hubert Ladenburg*.

*Wheat Studies of the Food Research Institute*—

*April 1942*—Variability in wheat yields and outputs. Part I. Cycles or random fluctuations: *V. P. Timoshenko*.

*November 1942*—New international wheat agreements: *J. S. Davis*.

## INTERNATIONAL—

*International Labour Review*—

*November 1942*—Industrial relations and the determination of conditions of employment in wartime: *L. Bessling*.

*December 1942*—"A new structure of social security": The work of the Inter-American conference on social security at Santiago de Chile: Wartime economic and social organisation in Free China.

*January 1943*—Joint production committees in United States war plants: *W. Ellison Chalmers*.

## LIST OF ADDITIONS TO THE LIBRARY

Since the issue of Part III, 1942, the Society has received the publications enumerated below:—

## I.—OFFICIAL PUBLICATIONS

## (a) United Kingdom.

*Education, Board of.* An outline of the structure of the educational system in England and Wales. 4th ed. (Educational Pamphlet No. 94.) London: H.M.S.O., 1942. 7" × 4½". 38 pp. 9d.

*Education, Board of, and Ministry of Health.* Not yet five; children over two in war time nurseries. London: H.M.S.O., 1942. 8½" × 5½". 21 pp. 3d.

*Home Office.* Report of the Committee on Electoral Machinery. London: H.M.S.O., 1942. Cmd. 6408. 9½" × 6". 47 pp. 9d.

*Inter-Allied Information Committee, London.*

Conditions in occupied territories, 4. Axis oppression of education. London: H.M.S.O., 1942. 9½" × 6". 20 pp. 3d.

— 5. The penetration of German capital into Europe. London: H.M.S.O., 1942. 9½" × 6". 32 pp. 3d.

*Labour and National Service, Ministry of.* Welfare outside the factory and seamen's welfare in port, August 1941–August 1942. London: H.M.S.O., 1942. Cmd. 6411. 9½" × 6". 12 pp. 2d.

*Scottish Office.* Report of the committee on hydro-electric development in Scotland. Edinburgh: H.M.S.O., 1942. Cmd. 6406. 9½" × 6". 38 pp. 9d.

*Scotland, Department of Health.* Government education scheme. . . . Hostels for children. (D.H.S. Memo. 168/1942.) Edinburgh: H.M.S.O., 1942. 7" × 4½". 15 pp. 3d.

*Parliament.*

Report of Inter-Departmental Committee on the rehabilitation and resettlement of disabled persons. London: H.M.S.O., 1943. Cmd. 6415. 9½" × 6". 49 pp. 9d.

Social insurance and allied services: Report by Sir William Beveridge. London: H.M.S.O., 1942. Cmd. 6404. 9½" × 6". 299 pp. 2s.

— Memorandum from organisations: appendix G to report by Sir William Beveridge. London: H.M.S.O., 1942. Cmd. 6405. 9½" × 6". 244 pp. 2s.

— The Beveridge report in brief. London: H.M.S.O., 1942. 8½" × 5½". 63 pp. 3d.

*Royal Commission on Tuberculosis.*

Report of the Royal Commission appointed to inquire into the effect of food derived from tuberculous animals on human health. Part I. C. 7703. 1895. 24 pp. Part II, Part III. C. 7992. 1896. vi + 114 pp., xii + 302 pp. London: 1895–96. 13" × 8½". 1 vol.

Report of the Royal Commission appointed to inquire into the administrative procedures for controlling danger to man through the use as food of the meat and milk of tuberculous animals. Part I. C. 8824. 1898. 27 pp. Part II. C. 8831. 1898. 454 pp. London: 1898. 13" × 8½". 1 vol. (From Miss J. C. and Dr. F. M. Hamer.)

*Select Committee on National Expenditure.*

Session 1941–42. Reports: 16th. Organisation and control of the Civil Service. 55 pp. 1s. 17th. Merchant shipbuilding and repairs. 20 pp. 4d. 18th. Production (war materials). 11 pp. 2d. 19th. Aerodrome construction. 15 pp. 3d. 20th. Housing work of the Ministry of Aircraft Production. 4 pp. 1d. 21st. The work of the Committee in session 1941–42. 7 pp. 2d. London: H.M.S.O., 1942. 9½" × 6". 6 parts.

— Minutes of the proceedings of the Committee, together with an index to the reports, session 1941–42. London: H.M.S.O., 1943. 9½" × 6". 32 pp. 6d.

Session 1942–43. Reports: 1st. The organisation of the Committee. 4 pp. 1d. 2nd. Replies from Departments to recommendations. 27 pp. 6d. 3rd. Health and welfare of women in war factories. 24 pp. 4d. London: H.M.S.O., 1942. 9½" × 6". 3 parts.

(a) United Kingdom—*Contd.**Trade, Board of.*

Prices and margins. Traders' guide to price control of utility and non-utility cloth, apparel, bedding and household textiles. October 1942. London: H.M.S.O., 1942.  $8\frac{1}{2}" \times 5\frac{1}{2}"$ . 108 pp. 1s.

Scheme for ensuring fair shares of supplies for small retailers of clothing. London: H.M.S.O., 1942.  $9\frac{3}{4}" \times 6"$ . 8 pp. 2d.

Scheme for ensuring fair shares of supplies for small retailers of hollow-ware. London: H.M.S.O., 1942.  $9\frac{1}{2}" \times 6"$ . 6 pp. 1d.

Scheme for ensuring fair shares of supplies for small retailers of pottery. London: H.M.S.O., 1942.  $9\frac{1}{2}" \times 6"$ . 6 pp. 1d.

*Treasury.* The Defence (Finance) Regulations 1939 . . . together with a classified list of orders made under the Defence (Finance) Regulations, 1939, and in force on the 11th Nov., 1941. London: H.M.S.O., 1942.  $9\frac{3}{4}" \times 6"$ . 32 pp. 6d.

*Vaccination Commission.* Report of the Royal Commission appointed to inquire into the subject of vaccination; with minutes of evidence and appendices. 1st Report. C. 5845. 1889. 132 pp. 2nd Report. C. 6066. 1890. viii + 313 pp. 3rd Report. C. 6192. 1890. vi + 233 pp. 4th Report. C. 6527. 1893. x + 519 pp. 5th Report. C. 6666. 1892. 3 pp. 6th. Report. C. 7993. 1897. x + 779 pp. Final Report. C. 8270. 1896. vi + 221 pp. Appendix III. C. 8609. 1897. 142 pp. Appendix IV. C. 8610. 1897. 22 pp. Appendix V. C. 8611. 1897. 98 pp. Appendix VI. C. 8612. 1897. 66 pp. Appendix VII. C. 8613. 1897. 182 pp. Appendix VIII. C. 8614. 1897. 235 pp. Appendix IX. C. 8615. 1897. 453 pp. London: 1889-97.  $13" \times 8\frac{1}{4}"$ . 6 vols. (From Miss J. C. and Dr. F. M. Hamer.)

*Works and Planning, Ministry of.* Payment by results. Trade operations for which bonus rates have been fixed up to and including December 1942. Memorandum on Essential Work (Building and Civil Engineering) Order, 1941. 2nd ed. London: H.M.S.O., 1943.  $9\frac{1}{2}" \times 6"$ . 32 pp. 6d.

## (b) British Empire.

## Ceylon—

Report on incidence of taxation. (Dr. B. B. Das Gupta.) October 1942. (Sessional paper VII., 1942.) Colombo: 1942.  $9\frac{3}{4}" \times 6"$ . 55 pp. 85 cts.

## India—

*Bombay Government.* Report of the Bombay Economic and Industrial Survey Committee 1938-1940. Volume I. Bombay: 1940.  $9\frac{1}{2}" \times 6"$ . 209 pp. 10d.

## (c) Foreign Countries.

## Brazil—

*Rio Grande do Sul Diretoria de Estatística Educational.* Estatísticas culturais de 1940. Porto Alegre: 1942.  $10\frac{1}{2}" \times 7"$ . 102 pp.

## Portugal—

*Instituto Nacional de Estatística.*

VIII recenseamento geral da população (em 12 de dezembro de 1940). Resultados provisórios nos distritos, concelhos e freguesias do continente e ilhas relativos ao número de famílias e à população presente por secos. Lisboa: 1942.  $10\frac{1}{4}" \times 7\frac{1}{4}"$ . 61 pp. \$15.

Estatística das sociedades: Ano de 1940. Lisboa: 1942.  $10\frac{1}{4}" \times 7\frac{1}{4}"$ . 171 pp.

## Spain—

*Ministerio de Trabajo. Direccion General de Estadística.* Zona de Protectorado y de los territorios de soberanía de España en el Norte de África: Anuario estadístico 1941. Madrid: 1942.  $9\frac{1}{2}" \times 6\frac{3}{4}"$ . 319 pp.

## (c) Foreign Countries—Contd.

## United States of America—

- Department of Agriculture.* Circular No. 638. A compilation of the vitamin values of foods in relation to processing and other variants. Washington: 1942. 9 $\frac{1}{4}$ "  $\times$  5 $\frac{3}{4}$ ". 244 pp.
- Miscellaneous Publication No. 462. Family income and expenditures. Southeast region Part 1, family income. (Consumer purchases study: Farm series.) Washington: 1941. 9"  $\times$  6". vi + 208 pp. 25c.
- Technical Bulletin No. 787. Influence of variety, environment, and fertility level on the chemical composition of soybean seed by J. L. Carrter and T. H. Hopper. Washington: 1942. 9"  $\times$  5 $\frac{3}{4}$ ". 66 pp. 15c.
- No. 820. Growing tobacco as a source of nicotine by J. E. McMurtrey, Jr. C. W. Bacon and D. Ready. Washington: 1942. 9 $\frac{1}{4}$ "  $\times$  6". 38 pp. 10c.
- No. 824. Machining and related characteristics of southern hardwoods by E. M. Davis. Washington: 1942. 9"  $\times$  5 $\frac{3}{4}$ ". 42 pp. 15c.
- Department of State.* Peace and war. United States foreign policy 1931–1941. The official American document issued by the Department of State, Washington. (Department of State Publications No. 1852.) London: H.M.S.O., 1943. 9 $\frac{3}{4}$ "  $\times$  6". 96 pp. 1s.
- Temporary National Economic Committee.* Investigation of concentration of economic power . . . Monograph No. 12. Profits, productive activities and new investment. (76th Congress, 3rd Session Senate Committee Print.) Washington: Government Printing Office, 1941. 9"  $\times$  6". xx + 188 pp.

## (d) International.

## International Labour Office—

- Studies and Reports, Series A, No. 42. Joint production committees in Great Britain. Montreal: 1943. 9"  $\times$  6". iv + 74 pp. 2s.
- Series P, No. 4. Life-saving measures for merchant seamen in time of war. Statement prepared at the request of the Joint Maritime Commission. Montreal: 1942. 9 $\frac{1}{4}$ "  $\times$  6 $\frac{1}{4}$ ". 59 pp. 1s. 6d.

## League of Nations—

- Economic, Financial and Transit Department.* Commercial policy in the interwar period: international proposals and national policies. (1942. II. A. 6.) Geneva: 1942. 9"  $\times$  6". 164 pp.
- Economic fluctuations in the United States and the United Kingdom, 1918–1922. (1942. II. A. 71.) Geneva: 1942. 9"  $\times$  6". 93 pp.
- World economic survey, tenth year, 1941–42. (1942. II. A. 5.) Geneva: 1942. 9"  $\times$  6". 198 pp.
- Economic Intelligence Service.* The network of world trade: a companion volume to "Europe's Trade." (1942. II. A. 3.) Geneva: 1942 (Princeton, New Jersey). 10 $\frac{1}{4}$ "  $\times$  8". 171 pp. 5s.
- War-time rationing and consumption. (1942. II. A. 2.) Geneva: 1942 (London: Allen & Unwin). 9"  $\times$  6". 87 pp. 3s. 6d.

## II.—AUTHORS AND MISCELLANEOUS

- Barger (Harold).* Outlay and income in the United States, 1921–1938. (Studies in Income and Wealth, Vol. 4.) New York: National Bureau of Economic Research, 1942. 9 $\frac{1}{4}$ "  $\times$  6". xxvii + 391 pp. \$2.50.
- Belgian Information Office. Our daily bread. London: Lincolns-Prager, 1943. 7 $\frac{1}{4}$ "  $\times$  5". 24 pp.
- Browning (Andrew).* British political institutions. (The British Way, 4.) Glasgow: Craig & Wilson, 1943. 8 $\frac{1}{4}$ "  $\times$  5 $\frac{1}{4}$ ". 52 pp. 1s.
- Czechoslovak Research Institute. Post-war provision of vitamins, by Dr. Jindřich Back. London: 1943. 9 $\frac{1}{4}$ "  $\times$  6 $\frac{1}{4}$ ". 31 pp.

Authors and Miscellaneous—*Contd.*

- Davison (Ronald C.)*. Insurance for all and everything: a plain account and a discussion of the Beveridge plan. London: Longmans, Green, 1943.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . 32 pp. 1s. 6d.
- Ford (Walter)*. Belgian Africa's total war. London: Evans Brothers, Ltd.  $7\frac{1}{4}'' \times 5''$ . 56 pp.
- Harvard University. Graduate School of Business Administration. Bureau of Business Research. Bulletin No. 113. Operating results of department and specialty stores in 1940 by *Malcolm P. McNair*. Boston, Mass.: Bureau of Business Research, 1941.  $11'' \times 8\frac{1}{2}''$ . vi + 40 pp. \$2.50.
- Bulletin No. 114. Expenses and profits of limited price variety chains in 1940 by *Elizabeth A. Burnham*. Boston, Mass.: Bureau of Business Research, 1941.  $11'' \times 8\frac{1}{2}''$ . vi + 34 pp. \$1. (From Mr. J. Menken.)
- Hersch (Liebmann)*. La méthode des potentiels-vie appliquée à l'étude du mouvement naturel de la population. (Extrait de la Revue de L'Institut International de Statistique 1942: 3/4.)  $10\frac{1}{2}'' \times 7\frac{1}{4}''$ . 32 pp.
- De quelques potentiels-vie et de certaines variétés de vie moyenne. (Extrait de la Revue de L'Institut International de Statistique 1940: 3/4.)  $10\frac{1}{2}'' \times 7\frac{1}{4}''$ . 34 pp. (From the author.)
- Hetherington (H. J. W.)*. A comment on British democracy. (The British Way, 1.) Glasgow: Craig & Wilson, 1943.  $8\frac{1}{4}'' \times 5\frac{1}{2}''$ . 48 pp. 1s.
- Hubbard (Leonard E.)*. Soviet labour and industry. London: Macmillan, 1942.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . xv + 314 pp. 15s.
- The economics of Soviet agriculture. London: Macmillan, 1939.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . xii + 315 pp. 12s. 6d.
- Laird (John)*. The temper of British ideals. (The British Way, 2.) Glasgow: Craig & Wilson, 1943.  $8\frac{1}{4}'' \times 5\frac{1}{2}''$ . 51 pp. 1s.
- Leake (P. D.)*. Balance sheet values: the limitations of industrial accounting. Potters Bar: Gee & Co., Ltd., 1943.  $8\frac{1}{4}'' \times 5\frac{1}{2}''$ . x + [1] + 75 pp. 6s.
- Lever Brothers & Unilever, Ltd. The problem of unemployment . . . Jan. 1943. London: 1943.  $8\frac{1}{4}'' \times 5\frac{1}{2}''$ . 38 pp.
- London (University of), University College. Department of Statistics. Table of the coefficients of Everett's central-difference interpolation formula, by *A. Thompson*. 2nd ed. (Tracts for Computers, No. V. Edit. by E. S. Pearson.) Cambridge: The University Press, 1943.  $9\frac{1}{4}'' \times 6\frac{1}{4}''$ . viii + 32 pp. 5s.
- Mather (K.)*. Statistical analysis in biology. London: Methuen, 1943.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . 247 pp. 16s.
- Macfie (A. L.)*. The British way in world trade. (The British Way, 5.) Glasgow, Graig & Wilson, 1943.  $8\frac{1}{4}'' \times 5\frac{1}{2}''$ . 64 pp. 1s.
- Mansbridge (Albert)*. "Wise for thy houses." (Design for Britain Series, 3.) London: Dent, 1942.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . 31 pp. 6d.
- Morgan (E. Victor)*. The theory and practice of central banking, 1797-1913. (Cambridge Studies in Economic History.) Cambridge: University Press, 1943.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . xi + [1] + 352 pp. 15s.
- National Institute of Economic and Social Research. The population of Bristol. By *H. A. Shannon* and *E. Grebenik*. (Occasional Papers, II.) Cambridge: University Press, 1943.  $9\frac{1}{2}'' \times 6\frac{1}{4}''$ . 92 pp. 7s. 6d.
- National Bureau of Economic Research. Income size distributions in the United States, Part I. By the Conference on Research in Income and Wealth. (Studies in Income and Wealth, Vol. 5.) New York: N.B.E.R., 1943.  $9\frac{1}{2}'' \times 6''$ . xxvi + 131 pp. \$1.
- Nuffield College. Industry and education: a statement. Oxford University Press, 1943.  $7\frac{1}{4}'' \times 4\frac{1}{4}''$ . 38 pp. 1s.
- O'Brien (George)*. Economic relativity: opening address of the President . . . Delivered on 16th Oct., 1942. Dublin: The Statistical & Social Inquiry Society of Ireland, 1942.  $9\frac{1}{2}'' \times 6''$ . 32 pp. 2s.
- Office Management Association. Clerical salaries analysis, 1942: under the auspices of The London School of Economics and Political Science. London: 1943.  $9\frac{1}{4}'' \times 5\frac{1}{2}''$ . 48 pp. Members, 5s. Non-Members, 10s.
- Pollitt (George P.)*. Britain can feed herself. London: Macmillan, 1942.  $8\frac{1}{2}'' \times 5''$ . 51 pp. 3s. 6d. (From the author.)
- Robson (Lawrence W.)*. Current developments in industrial accountancy. Potters Bar: Gee & Co., Ltd.  $8\frac{1}{2}'' \times 5\frac{1}{2}''$ . 28 pp. 2s.

**Authors and Miscellaneous—Contd.**

- Saulnier (Raymond J.) and Jacoby (Neil H.)*. Accounts receivable financing. (National Bureau of Economic Research. Financial Research Program, Studies in Business Financing.) New York: N.B.E.R., 1943. (London: Macmillan.) 9" × 6½". xv + 154 pp. \$2.
- Tiwari (R. D.)*. Modern commercial policy: a study in technique. Bombay: New Book Co., 1942. 8¾" × 5½". xviii + 472 pp. + x pp.
- White (A. K.)*. The British method of government. (The British Way, 3.) Glasgow: Craig & Wilson, 1943. 8¼" × 5½". 63 pp. 1s.
- Winslet (Victor G.)*. Multiple shop companies. 2nd ed. Potters Bar: Gee & Co., Ltd., 1943. (London: City Library.) 8¼" × 5½". viii + 75 pp. 10s.
- Yarsley (V. E.) and Couzens (E. G.)*. Plastics in the home. (Design for Britain Series, 22, Second Series.) London: Dent, 1943. 8½" × 5½". 31 pp. 6d.



## PERIODICALS RECEIVED BY THE LIBRARY

### ANNUAL LIST

In addition to the publications named in the bi-monthly lists, the Society has received during the past year the official and other periodicals enumerated below.

#### (a) United Kingdom and its several Divisions

##### *National*

##### **United Kingdom—**

*Admiralty.* Navy appropriation account.  
*Agriculture and Fisheries, Ministry of.* Journal of the Ministry of Agriculture.  
*Air Ministry.* Air services appropriation account.  
*General Register Office.* Registrar-General's weekly return of births and deaths. Quarterly return of births, deaths and marriages.  
*Health, Ministry of.* National Health Insurance Fund accounts. Summary report by the Ministry of Health.  
*Home Office.* Aliens (naturalization) return. State management districts (Licensing Act 1921) report.  
*Imperial Agricultural Bureau.* Annual report of the Executive Council.  
*Labour and National Service, Ministry of.* Annual report of the Chief Inspector of Factories. Ministry of Labour gazette.  
*Medical Research Council.* Bulletin of war medicine.  
*Parliament.* The public general acts and the Church Assembly measures.  
*Stationery Office.* Government publications, consolidated list.  
*Trade, Board of.* Annual statement of the trade of the United Kingdom. Board of Trade journal.  
*Treasury.* Account of the public income and expenditure. Civil appropriation accounts. Civil estimates. Finance accounts. Financial statement. Revenue departments appropriation accounts.  
*War Office.* Army appropriation account.

##### *Municipal and other local returns*

LIVERPOOL: Report on the health of the City. MANCHESTER: Abridged report on the health of the City. SHOREDITCH: Abridged report on the health . . . of the Metropolitan Borough.

##### **Scotland—**

*Agriculture, Department of.* Scottish journal of agriculture.  
*Health, Department of.* Summary report.  
*Registrar-General.* Births, deaths and marriages [weekly and quarterly returns].  
 GLASGOW. Report of the Medical Officer of Health.

##### **Northern Ireland—**

*General Register Office.* Quarterly return of births, deaths and marriages.

##### *Miscellaneous Publications*

Accountant. Accountants' magazine. Agenda. Alliance news. Anglo-Swedish review. Annals of eugenics. Association for Planning and Regional Reconstruction, Broadsheet. Auctioneers' and Estate Agents' Institute, Journal.  
 Banker. Bankers' almanac and year-book. Bankers' Clearing House, annual statement. Bankers' magazine. Bank of England, Statistical summary. Barclay's Bank, Report of Ordinary General Meeting. Belfast, Queen's University calendar. Biometrika. Brewers' almanack and wine and spirit trade annual. British Association for the Advancement of Science, The advancement of science. Building industries survey. Building societies year-book.  
 Cambridge University abstract of dissertations. Chamber of Commerce journal. Chamber of Shipping of the U.K., annual report. Chartered Surveyors' Institution, Journal. Colliery guardian. Co-operative Union Ltd.: Co-operative review. Report of the annual co-operative congress. Corporation of Foreign Bondholders, annual report. Czechoslovak Medical Association in Great Britain, Bulletin.

(a) **United Kingdom and its several Divisions—Contd.***Miscellaneous Publications—Contd.*

Dalgety's annual wool review.

Economic journal. *Economica*. *Economist*. *Economista* Polski. *Eugenics* review.Fabian Society: *Fabian news*, *Fabian quarterly*, *Research series*, *Tract series*.Faculty of Actuaries: *Transactions*, *Year-book*. *Financial review of reviews*. *Fireman*.*Geographical journal*.*Health and empire*.Incorporated Association of Rating and Valuation Officers, *Journal*. Institute of Actuaries: *Journal*, *Year-book*. Institute of Bankers, *Journal*. Institute of Industrial Administration, *Journal*. Institute of Petroleum: *Annual reviews of petroleum technology*. *Insurance directory and year-book*. International Federation of Trade Unions, *Bulletin*. International Sugar Council, *Statistical bulletin*. Iron and Steel Institute, *Journal*.King Edward's Hospital Fund: *Annual report*, *Statistical summary*.*Land and liberty*. London and Cambridge Economic Service: *Bulletin*.Mallett and Co., *Weekly wool chart*. Manchester school. Manchester Statistical Society, *Transactions*. Manchester University calendar. *Municipal year-book*.National Association for Prevention of Tuberculosis: *Report of Council*. National Institute of Economic and Social Research, *Diary*. *Nature*.Oxford Institute of Statistics: *Annual report*, *Bulletin*, *Oxford economic papers*.Peabody Donation Fund, *Annual report of Governors*. *People's year-book*. *Planning*. *Post magazine*. *Public administration*. *Publishers' circular*.*Quarterly journal of mathematics*.Rates levied on various towns. Registered accountant. Registered Accountants' year book. Review of economic studies. Royal Agricultural Society of England, *Journal*. Royal College of Surgeons of England, *Calendar*. Royal Institute of International Affairs, *Annual report of the Council*. Royal Institution, *Proceedings*. Royal Meteorological Society, *Journal*. Royal Sanitary Institute, *Journal*. Royal Society of Arts, *Journal*. Royal Society of Edinburgh: *Proceedings*, *Transactions*.Samuel Montagu and Co.: *Monthly letter*, *Annual bullion review*. Secretary. Seyd (R.E.), *statistics of failures*. *Signal*. Society of Incorporated Accountants and Auditors, *Year book*. *Sociological review*. *Statesman's year book*. *Statist*.Tattersall's cotton trade review (Dec. issue). *Taxation*. *Times*. *Times literary supplement*. *Times trade and engineering*. *Tin*.*United empire*.*Vacher's parliamentary companion*.*Whitaker's almanack*. *Who's who*. *Willing's press guide*.(b) **British Empire****Australia—***Bureau of Census and Statistics*. Finance. *Monthly review of business statistics*. Pocket compendium of Australian statistics. Press notices. Production. *Quarterly summary of Australian statistics*.*Commonwealth Grants Commission*. Report.Commonwealth Bank of Australia. *Statistical bulletin*.*Economic record*.**NEW SOUTH WALES—***Bureau of Statistics and Economics*. Official year book of New South Wales. *Statistical bulletin*. *Statistical register*.*Department of Railways*. Report of the Commissioner for Railways.*Parliament*. Report of the Auditor-General. Schedule for the estimates.**QUEENSLAND—***Government Statistician's Office*. Queensland year-book. *Statistics of the State of Queensland*.

(b) **British Empire—Contd.****SOUTH AUSTRALIA—**

*Statistical Office.* Statesman's pocket year-book. Statistical register.

**TASMANIA—**

*Bureau of Census and Statistics, Tasmania Branch.* Pocket year book of Tasmania.  
Statistics of the State of Tasmania.

*State Finance Committee.* The Tasmanian economy.

**VICTORIA—**

*Office of the Government Statist.* Victorian year-book. Annual report on friendly societies.

**WESTERN AUSTRALIA—**

*Government Statistician's Department.* Pocket year-book. Quarterly statistical abstract. Statistical register.

*Registrar of Friendly Societies.* Report of proceedings.

**Canada—**

*Bank of Canada.* Statistical summary.

*Department of Agriculture.* Report of the Veterinary Director-General.

*Department of Finance.* Public accounts.

*Department of Justice.* Annual report of the Superintendent of Penitentiaries.

*Department of Labour.* Labour gazette. Prices in Canada and other countries.  
Wages and hours of labour.

*Department of Public Works.* Report of the Minister of Public Works.

*Dominion Bureau of Statistics.*

*External Trade Branch.* Trade of Canada.

*Fisheries and Animal Products Branch.* Fisheries statistics. Statistics of dairy factories.

*Forestry Branch.* Census of Industry: Lumber industry, Pulp and paper industry.

*General Statistics Branch.* Canada year book. Monthly review of business statistics.

*General Manufactures Branch.* Manufacturing industries of Canada, summary report. Textile industries of Canada.

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